THE BOOK

OF

ILLUSTRIOUS MECHANICS,

OF

EUROPE AND AMERICA.

TRANSLATED FROM THE FRENCH

OF

EDWARD FOUCAUD.

NEW EDITION, WITH A SUPPLEMENTARY CHAPTER ON AMERICAN MECHANICS AND THEIR INVENTIONS.

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HARTFORD:
PUBLISHED BY W. J. HAMERSLEY.

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INTRODUCTION.

TO WORKING-MEN.

THE celebrated Lamennais has said: "The mechanic rises before day, lights his little lamp, and labours diligently to gain a livelihood for himself and his children." When Lamennais inscribed this sentence in his admirable *Words of a Believer*, he gave a complete summary of a working-man's life.

Work, work on, work ever: such is the inscription which glit-

ters on the standard of every mechanics' association.—At the first glance, such an existence wears a melancholy aspect; but soon, in enlarging its objects, and in consecrating all its hours to laborious occupation, it adds a new and continually increasing lustre to the already brilliant crown of industry.

I have thought it a great and honourable task, to write the history of the mechanic, the humble and modest annals of the working-man, who has devoted all his faculties to manual labour; and I think this task will be appreciated by all, because it is great; understood by all, because it is honourable.

I had originally divided this work into three great historical periods:—from the time of Francis the First, to 1789;—from the Republic to the revolution of 1830,—and from 1830 to the present day. But at the time of preparing the work, the first of these great divisions, although perhaps one of the most curious, eluded all research. If we turn to history, we find nothing there. Mechanical ingenuity seems to have had no existence in the early ages, or at least an obscure and unimportant one. If we seek the date of a disastrous war, the historian is scrupulously exact; but if we inquire of him a brief account of the progress of arts, he is silent, or gives uncertain and incomplete data, as if he were ashamed to enter upon so insignificant a subject.

From the time of Francis the First until the end of the eighteenth century, industry has had no historians. I have not therefore been able to enter fully upon my subject, until after this epoch, and have been obliged to content myself with giving a general sketch of the first memorable advancement of manual labour, that queen of nations.

Let me not be misunderstood. The history I am about to publish is not written in a biographical style; I am fully aware that such would be tedious and uninteresting, as well as unnecessary. The *illustrious mechanics* will contain an account of the labourer at his work-bench, tools in hand, and every piece of handicraft whose object has been the improvement of any one

art will be here recorded; and if the subject sometimes diverges into the privacy of families, it will be but for the sake of casting a few flowers on the lonely path of some who have been most unjustly the victims of adversity.

When an architect has decided upon a plan for the foundation of his edifice, he reflects long and well upon it, lest it should present to the eye of an observer any defect in the arrangement; nor is he satisfied until the slightest details harmonize and form a perfect whole. In striving to bring my work to perfection, a work of a popular nature, and one conceived in the liberal and progressive spirit of the age, I have deemed it advisable to give a place in it to every man of low birth, who, by manual labour, by deeds of generosity or of self-devotion, has rendered his name distinguished. Such are the *illustrious mechanics*.

Thus, side by side with the mechanic Jacquarel, the agriculturist Graugé, &c., the reader will find the illustrious Ney, Duke of Elchingen, and Prince of Moscowa, entitled in battle, *the bravest of the brave;* Lannes, the dyer's apprentice, who, after enjoying all the grades of military honour, was made Duke of Montebello by Napoleon; Augereau, general of the Empire, son of a Paris fruit-seller; Bernadotte, son of the humble citizen of Bearn, placed upon the throne of Sweden, under the name of Charles John; Murat, the intrepid soldier, who woke up one morning King of Naples—he, the child of the tavern-keeper! and numbers of others.

Other names will also be registered in our work, names not less known, nor less beloved by the people.

Monthyon, for instance, the beneficent man, whose devotion to the virtuous and meritorious classes was so great.

Jacques Lafitte, who, previous to becoming the aid and support of the necessitous, understood by experience the pains and penalties of manual labour.

Neither shall I omit to mention those who have made a noble use of hereditary or acquired wealth, by devoting it to the succour of the labouring classes, at periods of public distress. At

Peter the Great at Saardaam.

the head of these stands the *little blue cloak.* The *illustrious mechanics* will be, according to the "Siècle," a sort of Pantheon of the working classes, and the benefactors of industry.

There are two illustrations of our subject. One consists of a rich man who voluntarily gives up a portion of his time to the exercise of manual labour. Among these we may enumerate Peter the Great, who, a hatchet on his shoulder, and the broad belt of a slave round his waist, repaired to a timber-yard, at Saardaam, to learn stone-cutting and carpentry.

Let us enter a work-room. A bench with richly carved legs stands in front of an open window, whose blue silk curtains are confined by cords of gold. On this bench glitter ivory-handled tools, inlaid with gold. Arm-chairs and sofas, of splendid form and materials, give the place the air of the boudoir of a lady of rank. Two men, whose hands are carefully covered with gloves, are engaged in examining a lock: one has the common courtier face, which always wears a mingled expression of devotion and servility: the other has a noble countenance, a royal one, although it expresses no great firmness of character. This work-room is that of the locksmith Louis XVI.

So much for the first illustration.

The other consists in a daily, an hourly, a momentary labour. The man who leads this life wears no gloves; his hands are hardened, his face is care-worn. Look for no luxury in his little room with its bare walls, no silk curtains on his little window.

Which of these examples does the most honour to the arts?

The white and perfumed hands of the nobleman of rank are in no wise better in the sight of God than the coarse and blackened ones of the common labourer.

Think not that the name of one of the nobles of the earth can ennoble labour; it may give it a temporary sort of vogue, among courtiers, but this is all; without it, the art would have prospered as well, perhaps a little later, but that is all.

About to begin my work, enveloped as it was in a cloud of difficulties, I hesitated . . . my thoughts refused to follow my pen. In fact, in the laborious life of the mechanic, I beheld but one long well-beaten track, one continual belief, one melancholy consolation, and these three had one object . . . that of incessant labour. But soon, in full view of the physical and moral sufferings of the working classes, a strong desire to repair a public injustice inspired me with courage to complete my task. I had asked myself the question, "Why should not the working-man enjoy equal privileges with the man of opulence?" It was in answering this question that difficulties arose; and in this state of indecision, mistrusting my own, perhaps too youthful powers, I applied for assistance to one of the greatest of modern philanthropists. The following is the answer I obtained:

Paris, October 25, 1838.

Sir:—You have done me the honour to inquire if I would consent to allow a history of *illustrious mechanics* to be published under my auspices.

I thank you for the sentiment which has induced you to offer me this dedication. You have believed, and justly, I am sure, that such a subject would excite my sympathy; on this, trust me, you may depend.

You will have need of great labour, in seeking out the materials for your work. The life of the mechanic is passed in the obscurity of his work-shop, an obscurity too profound to have ever attracted the attention of the historian. I am nevertheless convinced that, in this humble existence, there are often prodigies of industry and of virtue, requiring only a skilful interpreter, to be appreciated and to become useful as public examples. Be this interpreter, sir, and I do not hesitate to predict your success.

Believe me, sir, in assuring you of my highest regard,

J. LAFITTE.

The corner-stone was thus laid; but this was not enough; I had yet still to collect my materials, and arrange them with care and order. The better to accomplish the difficult task I had undertaken, I sought out a few names highly eminent in science, and now inscribe upon the frontispiece of a book dedicated to labourers, the names of MM. Charles Dupin, Blanqué the elder, and Arago. Under such auspices, let the *illustrious mechanics* walk proudly, for a crown is on their brow.

EARLY STATE OF THE MECHANIC ARTS.

HISTORY teaches us on every page, that the mechanic arts, in their progressive advancement, have kept pace with the various human sciences. To be assured of the truth of this fact, we have only to refer to the epoch immediately preceding that called the *Revival of Learning*, that is to say, the thirteenth and fourteenth centuries. At that period, the number of the principal mechanical or laborious professions, did not amount to more than one hundred. A list of these, extracted from various old documents, and interspersed with remarks, will give the reader an idea of the social condition of our forefathers; and in comparing it with our own, he will perceive the vast improvements made by the French in the useful arts, during the last five hundred years.

Bakers,
Millers,
Corn-Factors,
Measurers of Grain,
Criers,
Retailers of bread, salt, salt fish, fruits and garden stuffs,
Gaugers,
Brewers,
Innkeepers.

In the thirteenth and fourteenth centuries, all trades, being

kept in check by the limited wants of the people, were carried on independently of each other. The necessity for co-operation had not yet made itself felt. The baker baked his bread and sold it, with the sole ambition of making a few crowns. The miller and brewer were contented to make or sell their articles, without reflecting that flour and beer were susceptible of a high degree of improvement. All were in a state of apathy which was truly deplorable.

The innkeeper alone was freed from this slavery. In continual contact with all classes of society, he soon learned to be all things to all men; for from the working-man to the noble, the man-at-arms to the monk, all ranks gathered round the table in his drinking-room, where familiar conversation and drink brought them to one level.

Plumbers,	Joiners,
Farriers,	Wire-drawers,
Ironmongers,	Makers of iron bucklers,
Blacksmiths,	Nail-makers,
Locksmiths,	Makers of brass and copper bucklers,
Carpenters,	Armourers,
Stone-cutters,	Furbishers,
Masons,	Bone and coral bead-makers,
Cutlers,	Coral and jet bead-makers,
	Goldsmiths.

The armourer has been long out of date. The hauberk was a coat of mail of polished iron, with sleeves and a throat-piece; this, in those days, completed the armour of a knight. Bead-makers, now called chaplet-makers, were much in vogue in the fourteenth century. Few trades were so profitable, and the bead-maker was distinguished above other mechanics, by a peculiar grace and affability. A lady of rank thought it no degradation to rein in her white palfrey before the sculptured panels of his door; the young knight hastened his steps upon hearing that Master Such-an-one had finished a rich rosary.

For religion was in all hearts then; and one universal belief; and smiles from red lips mingled with the gold that paid for am-

ber, jet, and coral chaplets, and thoughts of love would sometimes light in the strangest manner on the string, as the beads were told at vespers.

The goldsmith was not less esteemed, although a very different man. Grave and distant, he laboured alone in his little work-shop, where resounded no songs to the Virgin, but blows of the hammer, interrupted by an occasional burst of laughter, or a volley of oaths.

In all other trades, each individual applied himself with assiduity, knowing that reward renders labour light. But to go on with our list:—

Cutters of crystal,
Silver thread-beaters,
Pewter-smiths,
Gold leaf-beaters,
Silk and thread lace-makers,
Silk spinners with large and small spindles,
Silk weavers,
Silk fringe-makers,
Tailors,
Silk, velvet, and cloth mercers,
Shoe-buckle makers,
Cloth weavers,
Fullers,
Dyers,
Manufacturers of Turkey carpets after the Saracen mode.

Luxury is the offspring of civilization. This truth is the more evident, as, in the earliest age of monarchy, those whom birth, talents, or military renown had elevated above their fellow-mortals, endeavoured to distinguish themselves by a display of magnificence and bounty. Robes of velvet and ermine succeeded to those of serge and linen; the breast-plate, incrusted with gold and silver, to that of polished iron. As early as the thirteenth and fourteenth centuries, weavers and drapers made great improvements in their respective trades. It is true, their stuffs had not the lightness and grace of those of the present day, but it is doubtful whether the dandies of the time of Francis I. would have consented to exchange their rich and gay costume for the plain, dark attire of a modern gentleman.

Thanks to the custom of the times, the dyer's purse was never empty: there was not then the competition of to-day; everything had its fixed price. And abundance, the invariable at-

tendant upon a demand for any sort of goods, required a prompt payment. A citizen's house was ornamented with elegantly sculptured furniture, and rich carpets.

Joiners,
Cask-makers,
Dress-makers,
Linen-drapers,
Dealers in hemp and thread,
Dealers in coarse canvass,
Pin-makers,
Makers of writing tables,
Mercers,
Sheath and case-makers,
Ornamentors of sheaths and cases,
Button-makers,
Ship-painters,
Makers of bows and arrows,
Makers of saddle-bows,
Harness-makers,
Saddlers,
Tanners,
Book-clasp makers,
Sculptors of images of the saints,
Bit-makers,
Dealers in hay,
Painters of armorial bearings on saddles,
Painters of images of the saints.

The tournament gave occasion for the display of many of these last-mentioned arts. After divine service, on Easter-day, whilst the wax-lights on the altar still smoked, and the incense lingered in the aisles, the knights assembled in the Place Saint Dénis; and all the roads leading to the gates of the city were thronged with people. Crowds of gayly equipped lords and ladies passed by, to the great delight of the noisy populace. Horses, whose rich trappings were dimmed by the moisture from their own bodies, impatiently awaited the beginning of the combats. But the joy of the people was short-lived; the tournament finished, the conqueror crowned, they returned with slow steps to their miserable homes, where want and privation formed a strange contrast to the splendour they had so recently witnessed.

The church has, in all ages, given profitable employment to various arts; such as the making of ornamental book-clasps, painting and making of images of the saints, &c. Indeed, no lady of rank could say her prayers unless on her knees before an image of the Virgin, or her patron saint, with her hands resting upon a missal with silver clasps.

Dealers in oil,
Tallow-chandlers,
Potters,
Makers of pewter vessels,

Comb and lantern makers,
Makers of drinking-cups and porringers,
Furriers,
Ladies' hat-makers,
Bath-keepers,
Barbers,
Royal fishermen,
Poulterers,
Purse-makers,
Shoemakers,
Leather shoemakers,
Lamp-makers,
Sheep-skin shoemakers,
Cobblers,
Curriers,
Garland-makers,
Makers of common cheap hats,
Makers of plumed hats,
Makers of cotton hats,
Dice-makers,
Fresh and salt fishmongers,
Cooks.

The fashion of wearing hats ornamented with peacocks' feathers has not come down to us, being too inconvenient a one for modern habits; for increasing civilization has taught us to prefer comfort and ease to to all other advantages.

In former times, no one wore a plain hat, and some of the ornaments in vogue were undoubtedly in very bad taste, but will not excite our surprise more than the pointed shoes of the same epoch, shoes consisting of two parts, one covering the whole of the instep, the other reaching up to the calf of the leg behind. It will, of course, be understood that they were peculiar to the higher classes; the lower being contented with a sort of gaiter of coarse leather.

Among the workmen we have enumerated, two have led to great evils among mankind: namely, the cook and the dice-maker. If it be true, as some philosophers have said, that idleness is the mother of all vices, it may, with equal truth, be affirmed, that many sins arise from the excitements of the table, and from gaming. Among the working classes, the evil passions exert a powerful and often a fatal sway. Good-natured, and easily persuaded to follow the example of his associates, the mechanic often yields to the seductions of vice. In the fourteenth century, dice-playing was very common, and all ranks of society yielded themselves with a sort of frenzy to the reason-destroying passion for gambling. The dice-maker became a rich man; the cook followed up the rear, and, together, they completed the ruin of

numbers. Watchmen found it a difficult matter to maintain peace and quiet, for street-brawls were frequent under cover of the darkness of night; nor was it rare for citizens to seek a deserted part of the city at dusk, and settle all disputes with their fists. Cavaliers, also, sword in hand, would seek reparation for losses at play.

Two friends would often meet in the little dominion of ten feet square, where reigned a despot in the midst of his dishes, the skilful preparer of a good dinner, and, seated at his table, the dice between them, and a vessel of strong liquor, they would pass some time in destroying an old friendship, and getting rid of their money. Fortunate if there ensued no violent combat, and if the knife, so lately used for carving the joint of meat, did not find its next resting-place in a human heart.

Civilization made rapid strides under the influence of the brilliant light shed upon the world by the invention of Printing. People began to feel new wants, and a favourable impulse was thus given to the intelligence of the labouring classes, either in improving upon what they already knew, or in inventing that in which they were deficient; so that from the fifteenth century, until the period of our memorable Revolution in 1789, a number of trades have been gradually perfected. The following are those which have made the greatest progress during that space of four centuries.

Hats were first worn in the country in 1380, under Charles VII.; in 1422, they were worn in town, but only in bad weather. The first beaver hat was worn by that king on his entrance into Rouen, in 1449; it was lined with red velvet, and had a piece of gold thread round it. The use of them was in some degree abandoned, under Louis XII.; but Francis I. adopt ing it, it became general. Under Henry IV., towards the end of the sixteenth century, hats became a very important branch of trade. They were not turned up, but lined with fur, and trimmed with gold and silver fringes, strings of pearls, and precious stones, for persons of rank. A string tied under the chin, kept them on. It is worthy of remark, that in Bretagne, the

use of hats was common among priests, as early as the eleventh century.

The first pins were fabricated, it is said, in England, in 1576; but a much better attested fact teaches us, that they were invented at Alençon, towards the year 1540; where, for a long time, more than six thousand workmen have been employed, a fact which will cease to astonish when we consider that more than eighty millions of pins of all sorts are annually sold in Paris. Formerly ladies made use of wooden skewers to fasten their dresses.

Although silk was well known and much used in France, in the fifteenth century, silk stockings were unheard of, they being worn of cotton or woollen, and always of the same colour as the dress. Henry II., in 1559, was the first king of France who wore knit stockings of silk, made by a woman whose name is unknown.

The stocking-loom was invented by a locksmith of Normandy, who sent a pair of stockings made in this manner to Colbert, to be transmitted to Louis XIV. Some jealous weavers bribed a valet to cut some of the stitches. This mean trick was the cause of the rejection of a machine, which the inventor carried to England, where it was eagerly received. It was carried back into France, in 1656, by Jean Ilindret, who, by a prodigious effort of memory, preserved the construction of it. A manufactory of stockings of this kind was established under the direction of this skilful mechanic, at the Chateau de Madrid, in the Bois de Boulogne. Its success was so great, that, in 1666, Ilindret formed a company, which, under the especial protection of the king, advanced so rapidly, that six years afterwards a community of master-workmen was established.

It is therefore in vain for the English to boast of this invention, and to endeavour to deprive France of the honour of it. It is well known that it belongs to a Frenchman, and to one whose original profession had no connection with the one adopted by him, which proves that he must have been endowed with rare intelligence, and increases the regret we cannot help feeling, at the obscurity which veils his name.

Gobelin.

CHAPTER I.

THE GOBELINS.

THE water of the Bièvre river, which bathes the southern extremity of the Faubourg Saint Marceau, was, in the fourteenth century, considered excellent for dyeing. Numerous drapers and dyers established themselves upon its banks, their houses and bleach-greens presenting a most picturesque and pleasing aspect, whilst the waters ran of every colour of the rainbow, resembling various strata of differently coloured minerals. On its banks may be seen, at

this day, a modest house of the architecture of the fifteenth century. This building was erected in 1450, by a dyer, whose talents gave him a high rank among his fellow-mechanics: the colours he imparted to his cloth were distinguished by their uncommon brilliancy. His name was Jean Gobelin. Fashion soon attached herself to the work of his industrious hands, and his sales were rapid; orders poured in upon him from distant places, so that he employed a very large number of workmen.

Jean Gobelin was a tall man, with a dignified countenance, and a mild disposition. Master of numerous workmen, he was also their friend; never forgetting that, whereas he now gave his orders, and was obeyed, he had once knelt on the ground, and washed the cloth in the waters of the Bièvre, with his own hands.

At his death, his son Philibert, and Denise Lebret, his wife, carried on the business, and increased the fortune he left them. By degrees they acquired the same celebrity, of which also the place, and the hitherto humble little Bièvre partook.

To the Gobelins, succeeded the Canaye family, who did not confine their labours to the mere dyeing of scarlet cloth, but also wove tapestry ; and were in turn succeeded, in 1655, by a Dutchman, named Gluck, and by Jean Liansen, who excelled all others. The beauty of his tapestry attracted the attention of Colbert, who resolved to put the establishment under the king's special protection, and to employ it in the royal service only. He procured an edict to that effect, in 1667, giving the direction of it to Lebrun, Louis XIV.'s first painter. It was in this place that were fabricated the splendid tapestries, the admiration of all Europe, and which surpass those of the Saracens in beauty of design and composition.

An important manufactory of carpets of the Flemish kind was established by letters patent which Sully obtained in 1607, and of which Marc Comans and François La Planche, skilful dyers, were made the directors. This manufactory was situated at the extremity of the Rue de Varennes, terminating in the Rue de la

Chaise, now become Rue de la Planche, from the name of one of the two directors. The privilege was continued to their children, by Louis XIII., and in 1667, Colbert annexed this establishment to that of the Gobelins. Finally, in 1688, Jean Papillon invented wall-paper, which has been in common use ever since.

André Graindorge, a weaver of Caen, in Normandy, was the first who ever made figured cloth, representing squares and flowers of all sorts upon it. Richard Graindorge, his son, improved upon his father's idea, by the representation of animals, birds, trees, houses, and even rural scenes, such as groups of hay-makers, rustic dances, Dutch smoking scenes, &c. He was also the originator of the use of table-cloths and napkins. His son, Michel, established manufactories in various parts of France, where damasks became a common article.

Louis XI. established silk factories at Tours in 1470. Nevertheless, it was not until the sixteenth century that this branch of trade became a profitable one. Henry IV. established silk factories at Paris, in the Louvre itself, and in the *Chateau de Madrid.* It is to this prince, and to his minister, Sully, that Lyons owes her first establishment of this kind on a large scale. Henry engaged men to go annually into Spain, in search of silkworms' eggs, and planted a great number of white mulberry trees in nurseries, in the neighbouring parishes.

In accordance with the solicitations of the manufacturers, he forbade the use of foreign silks; but revoked the edict, upon the remonstrances of those of Lyons.

In 1645, Octavius Meg invented a process for *giving a gloss* to silk, as it is termed in the manufactories. In 1717, Jurines, a master maker of fringes, ribbons, &c., made great improvements in the art of fabricating silk, and towards the year 1738, Falcon was the originator of an ingenious mechanism for alleviating the weariness attendant upon the old method of weaving thread.

The making of ribands, ornamental buttons, laces, &c., is a

branch of industry which has made a rapid and extensive progress up to the end of the eighteenth century; for it was always subject to the ever-varying caprices of fashion.

M. Peuchet, in his *Dictionary of Commercial Geography*, has given some curious details respecting this art, and although entirely of an abstract nature, they occupy too important a place in the dominion of industry, to be excluded from our notice.

"This art," says this learned writer, "may be traced to the most remote antiquity; the ornaments of the temple, and of the priests, at Jerusalem (Exodus xxviii. 29, and xxxviii. 18, 22), belonged to it. The manner in which the precious stones were arranged on the breast-plate of the high-priest was a species of embroidering, in the fullest sense of the word: also that on the belt (*et balteum opere plumarii*), on the veil of the sanctuary, and on that of the tabernacle (*et in introitu ejus opere plumarii.*) Aholibah was a skilful workman in all sorts of ornaments. (*Artifex egregius fuit et polymitarius atque plumarius ex hyachinthe purpura vernaculo et bysso.*)

Moses, in Deuteronomy, after having forbidden the Israelites to wear garments composed of a mixture of woollen and linen, commanded them to put fringe on the four corners of their robes (*funiculos in fimbriis per quatuor angulos*). Ezekiel, in enumerating the benefits of God, which he reproaches the Israelite women with having abused, after mentioning bracelets, necklaces, ear-rings, and ornaments of riband for the head, speaks of their robes of fine linen dyed and embroidered in diverse colours, *bysso et polymito et multis coloribus*.

Helen, in Homer, embroidered the combats of the Greeks and Trojans; and Virgil, imitated by Pliny, in the idea that the Phrygians were the inventors of embroidery, calls embroidered stuffs *Phrygiæ, Phrygionæ* (*et Phrygiam arcanio chlamydem*, &c.) And Apuleus gave Paris a robe embroidered in different colours."

All authors, acccording to those of Greece and of Rome, at-

tribute the invention and the use of striped, painted, and fringed clothing, as well as that embroidered or ornamented with gold and silver, to barbarous nations.

This art includes ribbons, bands, artificial flowers, laces, plumes of feathers, buttons, frogs, tassels, fringes, and such ornamental articles.

CHAPTER II.

GLASS.

GLASS was discovered at an early epoch; many improbable stories are handed down to us on this subject. The first regular historical record, is that given us by the author of *Researches among the Egyptians*; which teaches us, that at Diospolis, cups were made and glass cut, and gilded with admirable skill; colours were even made to change as you looked at them, from one tint to another; and Winckelman, in his *History of Art*, adds that the ancients understood making glass much better than the moderns. However that may be, the Phœnicians for a long time monopolized all the trade in glass, and according to Pliny and Strabo, the manufactories at Sidon were in a very advanced state, and those of Alexandria, under the Ptolemies, enjoyed an equal fame. The art of glass-making passed from Italy to France, and later, from France to England; that is to say, in 674, at the time of the

construction of the Abbey of Wiremouth, the church belonging to which was built by French masons and architects, after the Roman fashion. The French workmen (says the venerable Bede) ornamented the windows of the church and monastery with glass, and taught the English how to make it. Although France at that time had some glass-works, they were not much encouraged; the progress made afterwards is entirely owing to Colbert's efforts.

As soon as a few improvements in the mode of living taught men to replace their open tents by warm houses, the want of glass for windows began to be felt; for without it, it was impossible to exclude the cold and the inclemencies of the weather, without equally excluding the light of day.

But the discovery of glass remedied this difficulty.

In 1539, one morning in May, the inhabitants of the town of Saintes were surprised and displeased, to find that a new family had come to establish itself among them. But dislike soon gave place to admiration; the inhabitants of Saintes learned that the head of the family was named Bernard Palissy, a man renowned for his paintings on glass, and from that moment all feelings of enmity and jealousy disappeared. Perhaps the people thought of the windows of their poor church. Matters went on very well for some time, until Palissy, now having been two years at Saintes, saw a cup of some sort of composition, very beautifully turned and finished, and became immediately possessed with the idea of making a vase of similar construction.

Under the influence of this idea, he abandoned the employment which had before supported his family, spending all his time in kneading earth, and afterwards baking it. But his first endeavours were unfortunate, and poverty with all its horrors entered his house. No matter, Palissy struggled on, sustained by a hope that, although a beggar to-day, to-morrow he may have more gold than his strong-box will hold. But many to-morrows came, and no gold: his wife complained bitterly, and his children, their eyes streaming with tears, clasped their thin hands and im-

plored him to resume his old profession of painting on glass, by the profits of which they had lived so comfortably, but all in vain. Twenty years passed in this manner; Palissy remaining faithful to that one idea, although every one around him laughed at him and treated him as if he were insane, and some even went so far as to accuse him of sorcery and forgery. In the midst of all this, an apprentice who had been with him for a long time, suddenly declared his intention of leaving him, and claimed his wages. Poor Palissy, stripped of every thing he ever possessed, is obliged to give him a part of his own clothing. Left to himself, he then directed his steps to his oven, which was in the cellar. Alas! it wanted wood! What could he do? He ran into the garden and pulled down all the trellis-work, and the fire was soon blazing; but this did not last long.—Palissy, beside himself with anxiety, took one article of furniture after another, and threw them on the fire, in spite of the entreaties of his family; and at last success crowned his efforts. A long cry of joy echoed through the vaulted cellar, and made itself heard through the whole house; and when his wife came running down, expecting to find a raving maniac, she saw her husband standing motionless, his eyes fixed in amazement on a piece of pottery of splendid colours, which he held in both hands.

The genius of invention, a long time deaf to his cries, had at last laid the crown of success upon his head. Success, that magic sound to the ear of genius. Palissy had the faith which never deceives.

The rumour of his discovery spread far and wide. Poverty fled from his house. Henry III. sent for him to Paris, and gave him lodgings in the Tuileries; it was here that he obtained a patent for the invention of *Royal rustic pottery* of all sorts. He was now known by the name of Bernard of the Tuileries.

A skilful workman, Palissy also understood medicine, painting, and sculpture, handling equally well the pen and pencil, and possessing a depth of thought never existing but in a man of genius.

The edict against the Protestants, published in 1559, by Henry III. at Ecouen, did not spare Palissy. Professing the reformed religion, he was dragged to the Bastile, where he died in 1589. Henry III. went to see him in prison, and told him that he was afraid he would be obliged to leave him in the hands of his enemies.

"You have said repeatedly, sire, that you pity me," replied Palissy; "but I sincerely pity you. *Be obliged!*—that is no royal expression; I will teach you a kingly language. Nor you, nor all your people shall oblige me to bend my knees before statues. No! I will die first."

The invention of the fine opaque and solid enamels is due to the French. John Toutin, a jeweller of Châteaudun, in 1630, was the first, it is said, who made enamelled jewels. This style of painting, improved by Gribelin, his pupil, and afterwards by Dubré and Morliere, whose rings and watches were much sought after, led to the idea of attempting portraits in enamel, the execution of which was in a somewhat different style from those done at Limoges under Francis I.

Enamel is a particular preparation of glass, to which various colours are given. The art of enamelling on earthenware and metals, is very ancient. According to the early historians, the bricks of which the walls of Babylon were constructed, were enamelled with various figures. But this art remained long in a simple state, from which it did not rise until the time of Raphael and of Michael Angelo.

The art of making looking-glasses originated at Venice, which city furnished all Europe with them, until Colbert persuaded many of the workmen, who were Frenchmen, to return to France, and sent them to the manufactory founded, in 1651, by Eustache Grandmont and Jean Antoine Autonneuil, which was in a languishing condition, not being able to compete with the Venetians. He built the large houses used for that purpose, in the Rue de Reuilly, at a great expense, and made the whole establishment a royal one, so that, from that time, the French look-

ing-glasses were equal to the Italian, and some of them are superior in size and perfection to any in the world. A workman named Thevart, become master, in 1688, made great improvements, especially in the size. The establishment was then removed from Paris to Saint Gobin, in Picardy, where it now is, and where eight hundred workmen are employed.

CHAPTER III.

PORCELAIN, STEEL, TIN, &c

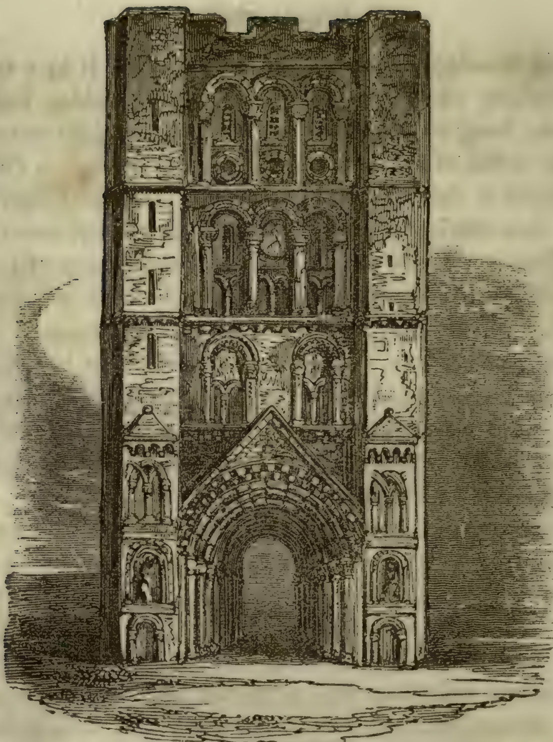
THE art of making porcelain originated ages ago. The Egyptians were acquainted with it, and we know that they used the same process as we do; so that it is probable that the art passed into Asia, and thence to China, where porcelain, called *tse-ki,* was common, as well as in Japan, four hundred and fifty years before Christ. The Portuguese imported this beautiful manufacture into Europe in 1517; they called it *loca,* whilst we, somewhat strangely, have borrowed their word *porcelana,* signifying a cup or porringer. The Chinese kept the precious composition a secret; but Baron Boeticher, chemist at the court of the Elector of Saxony, discovered it, in the seventeenth century, by combining different earths for the purpose of making crucibles. The rumour spread into France and England, where every chemist set to work to make porcelain, but in vain: until, at last, Mr. Tschirnhausen discovered a composition, to all appearances, similar to that in Saxony. He confided it to Mr. Homberg, in France, but they both died without having made the secret public. Reaumur guessed at the articles which must enter into the composition of the Chinese porcelain, and published some very just ideas concerning them, and the means of employing them. He made some, imitating the Saxon exactly, and thus gave France a useful art, as well as a new branch of commerce; and it was according to his directions, that the Marquis of Fulvy, governor of Vincennes, established there a porcelain manufactory, in 1738; but the success attending it was not equal to the zeal of the institutor, for the marquis lost all his fortune by it. In 1759, Louis XV. purchased the now almost desolate establishment, and transferred it to Sèvres. Mac-

quer and Montigny, excellent chemists, enriched it by a composition, uniting all the qualities necessary for making first-rate porcelain, being no other than the *kaolin* and the *petunse* of the Chinese earths, of an extreme whiteness, discovered in 1757 by M. Vilaris, at Saint Yriex, in Limousin. The manufactory at Sèvres then obtained a great celebrity, which it still maintains.

M. Reaumur is also the inventor of the discovery of turning iron into steel, a secret, before his time, utterly unknown in France. Tin was also first made under his directions.

This illustrious man, not yet content with all he had done for the human race, applied himself to the construction of a thermometer, which will maintain, in all places, equal degrees of heat and cold. This instrument bears his name, and is an imperishable monument to his glory.

It is said that tin was invented in Bohemia, towards the year 1610, by a priest of that country. Colbert introduced a number of those engaged in the manufacture of it into France, where they established a manufactory at Chesney, in Franche Comté, and at Beaumont Ferriere, in Nivernois; but at the death of the minister, not being well protected, and wanting in union among themselves, they left the country. At last, under the regency, in 1717, two manufactories were established at Strasburg, and at Massevaux, in Alsace; and successively at Bain, at Moramberg, and at Charité Sur Loire, where rapid improvements were speedily made in the malleability, the purity, and solidity of tin.



The Saxon Tower or Church Gate at Bury.

CHAPTER IV.

EBONY-WORK, LOCKS, SCULPTURE, ARCHITECTURE, AND VARIOUS OTHER ARTS.

FORMERLY the name of ebony was given to numerous beautiful woods, and the workmen employed upon them were called *Ebenists*. Besides the common black ebony, there was red, yellow, purple, &c. Although this is no longer the case at the present day, the name of *Ebenist* is still applied in France to those who work in mahogany, walnut, ash, and elm.

This is an ancient art; it was first practised in Asia, and after-

wards in Greece, at the time of Alexander's victories; it soon spread to Italy, and was much esteemed at Rome under the emperors, and highly thought of by all rich citizens. After the disorders caused by the northern invasion, it gained renewed splendour in the fifteenth century, contributing much to the beauty of the Vatican; whilst in all other countries the furniture was ugly and ungraceful. It was not until the end of the reign of Francis I., that it was cultivated with success in France, and in the beginning of the last century, this art underwent many changes. The French ebenists, from that time, have surpassed, in good taste and in talent, those of all Europe, and even of England, the only country which ever disputed the pre-eminence with them.

In ancient times, there were no locks on the doors. "People were contented," says Milline, "with a fastening of string." Although this was a poor and ineffectual mode, a better one was soon adopted. A bolt was placed transversely across the door, on the inside, (as is still done in some parts of the country:) in the bolt was fixed an oval piece of iron which served to fasten the door. This piece of iron was hollowed, and a sort of screw answered the purpose of a key. In order to shut or open the door from the outside, the hand was put through a hole made over the nut or screw.

The Lacedæmonian lock was invented soon after. This is formed of a piece of hard wood, six inches high, four inches broad, and one inch thick. In this are made four or five longitudinal grooves or mortises, three and a half inches long, half an inch broad, and three-quarters of an inch deep, which are occupied by tenons or forelocks of hard and heavy wood, moving freely and independently of each other. The bolt is arrested by these tenons, which, descending vertically, oppose its exit; which cannot be effected except by raising the tenons with the key.

A great improvement was afterwards made in locks, by placing the bolt in an iron capsule, for greater safety. The same may be

said of the Lacedæmonian key. Sometimes a second bolt was placed on the inside, and could not be opened externally.

After the return of the expedition to Egypt, wooden locks of great strength and solidity, although roughly made, were exhibited. Similar ones have been found in Pompeii and Herculaneum. This same lock has been handed down from antiquity, for more than four thousand years, in Egypt, where it is still used for the gates of houses, cities, and public places. The Turks, Arabs, and Greeks of the Archipelago, have also adopted it. In France, great improvements have been made in locks in the last hundred years. Destriches, Damour, and Gerard, have obtained a great reputation in this line all over Europe.

M. Charles Dupin relates the following facts.

Locks were formerly unknown to the lower classes. Every one understands that little Red Ridinghood's grandmother called to her from within, "Pull the bobbin, and the latch will fly up;" and as with this old woman, so was it with all. At the present day the peasant has a much surer method of securing his doors and windows.

Formerly, in city houses, the windows, which opened like a folding-door, were closed at the foot by an upright bolt of wood; but this has long been replaced by one of iron.

Watch and clock-making, the origin of which is unknown, reappeared in Europe in 760, and continued until the twelfth century, with no very great improvements until the discovery of the pendulum by Galileo, which being applied to it in the beginning of the seventeenth century, there arose a spirit of emulation among the clock and watch-makers, such as Lebon, Leroy, Gaudron, Enderlin, Thiout, Rivez, Duterbre, Romilly, Lepaute, Berthoud, &c., who added new discoveries, giving to France a just renown.

The goldsmith's art, that of working in gold and silver, obtained great importance in Europe at the time of the discovery of America, which circumstance provided an increase of metals.

Nevertheless, it was not until the middle of the seventeenth century that it rose to any height in France.

Carving, or sculpture in bas relief, on metals, has improved greatly. Ballin and Thomas Germain were already very skilful in this at the beginning of the eighteenth century, and acquired an incontestable celebrity by their beautiful handiwork.

We cannot help feeling some surprise when we consider the very trifling progress made in masonry, not in its principles, but in their execution, which may be said to have long remained stationary. Observe the manner in which foundations are laid, and displaced earth removed; the scarcity of materials, and the difficulty of transporting them from place to place. Every thing is done by the strength of the arm, or by means which should belong to an uncivilized nation, whilst, four thousand years ago, the Egyptians, and other nations, now extinct, used machines for removing and lifting stones, earth, &c. Nevertheless, a very mediocre intellect could supply this art with numerous improvements, valuable for saving time and labour.

Walls, among the ancients, were built of large stones, or bricks, two deep, and the interstices filled up with fragments of stone, &c., rudely thrown in, and which were united in a mat, with mortar. Vitruvius recognises two species of masonry, the *inertum*, which he regards as ancient, and the *reticulatum*, which he indicates as in use in his day, which was twenty-seven years before Christ. In fact, the aqueducts of Lyons and Frejus, and most of those in the vicinity of Rome, the mausoleum of Augustus, &c., are constructed in this manner. At the present day, we sacrifice solidity to beauty of appearance.

The machine for raising the waters of the Seine to the top of the Marly mountain, carrying it down again, and thence to Versailles, is, undoubtedly, the greatest invention of the time of Louis XIV. The elevated situation of Versailles, in the department of Seine-et-Oise, presented innumerable difficulties to the accomplishment of this vast project. But the age of Louis XIV., so fertile in superior minds, resolved one of the greatest

Rennequin Sualem.

problems in mechanics, and proved that there is no limit to human genius.

It was begun in 1676, and put in activity in 1682. It cost 7,000,000 livres, and the maintenance of it amounted to 71,016 livres.

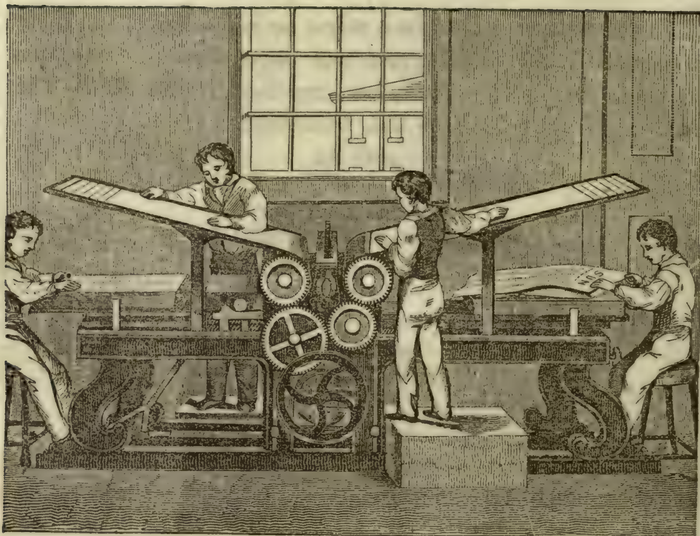
The mechanism of this admirable work is the conception of a carpenter of Liege, who could not read or write, named Rennequin Sualem, from whom the idea was taken by the Chevalier Deville, who was acquainted with Sualem's talents.

When this poor man came to intrust his project to him, he hastened with it to Paris, and offered the plan to Colbert, who shortly afterwards, by dint of intrigues and impudence, caused it to be believed that he was the inventor, and that the mechanic had been a passive instrument in his hands. So it is that the poor are sometimes the victims of the rich.

Sualem retired to Bougival, where he had a house, and there terminated a life of bitterness and disappointment. He was buried in the church in that place, together with his wife. The following is the epitaph on their tombstone.

HERE LIE
The honourable persons,
RENNEQUIN SUALEM,
Sole inventor of the Marly machine,
Who died July 29,
1708,
Aged 64 years;
And of MARIE NOUELLE, his wife.
Who died May 4,
1714,
Aged 84 years.

For a long time the Marly machine has been in disuse. It began to be observed that the amount of water transmitted decreased daily, whilst the expenses increased. The government endeavoured to discover a means of simplifying it, so as to lessen the latter. A meeting was held for that purpose in 1783, on motion of the Count d'Angivilliers, but with no good result. It was not until some years afterwards, that a new and less expensive mode of raising water to Versailles was discovered.



CHAPTER V.

PRINTING.

THE glorious art of printing was invented at Haarlem, in Holland, by Laurentius Coster, who used wooden characters. A man named John Geistfleisch, elder brother of Guttemberg, who worked as a mechanic under Laurentius Coster, carried away some of these types secretly to Mayence, his native place, where Guttemberg, taking advantage of this act of dishonesty, associated himself with Faust or Fust, a goldsmith, and began to print, aided by a young man, Peter Schœffer, who invented the use of metal types, in 1452.

It is not easy for us to imagine how many difficulties surrounded the first attempt at printing. Those who interested themselves in it, and printed cheaply, found themselves reduced to great poverty. More than six thousand writers were occupied at Paris, in copying and colouring manuscripts. Nevertheless, in

spite of all impediments, the art acquired great importance, as improvement after improvement was added, and success succeeded success. Paris beheld many printing establishments spring up one after another within her walls. The following is a list of the towns in which printing offices were successively established in the fifteenth century.

In 1475	one was	established at	Laguenais,
" 1477	"	"	Angers,
" 1479	"	"	Poitiers,
" 1480	"	"	Langres,
" 1483	"	"	Rouen and Vienne, (Dauphine,)
" 1484	"	"	Toulouse, Troyes, and Caen,
" 1486	"	"	Abbeville,
" 1487	"	"	Besançon,
" 1488	"	"	Nantes,
" 1489	"	"	Avignon,
" 1490	"	"	Dijon and Cleury,
" 1491	"	"	Rennes,
" 1492	"	"	Dole,
" 1493	"	"	Angouleme and Bourges,
" 1496	"	"	Troyes,
" 1497	"	"	Provins,
" 1499	"	"	Trevier,
" 1500	"	"	Orleans and Perpignan.

Printing, protected by Louis XI. and Louis XII., was in a short time powerful enough to resist all the machinations of its enemies. Having intellect on its side, it spread over all Europe with marvellous rapidity. The efforts of mind, which had heretofore died unheeded, now spread themselves through the mass of the people, enlightening, and improving, where mental darkness had before prevailed; but, like all great novelties, printing had its detractors.

Francis the First yielded to the complaints of the malcontents, and, on the 13th January, 1535, ordained the entire suppression of all printing in the kingdom, under penalty of hanging; but on the 23d of February following, the *Father of letters*, reflecting, perhaps, that there was something tyrannical and odious in such a decree, revoked it, and commanded the Parliament to send him

4 *

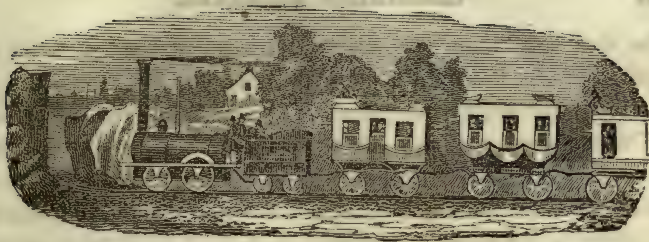
twenty-four persons, out of whom he would choose twelve, who alone should have a right to print such books as should be *approved* and *considered necessary*, and not *new compositions*.

Such was the origin of the royal printing establishment. Dulaure, in his *History of Paris*, places this institution in the reign of Louis XIII. According to him, France owes it to Cardinal Richelieu. It is true, it did not flourish until under Louis XIII., when it was established in the galleries of the Louvre; but I think Francis the First's edict of the 23d of February, 1539, may be considered as the foundation of it.

In 1642, Sublet, Sieur des Noyes, was made superintendent of the royal printing establishment; Trichet Dufrêne, corrector of the types, and Cramoisi, printer. During the space of two years, seventy large volumes, Greek, Latin, French, and Italian, were issued, and the expenses amounted to more than 300,000 francs, from 1642 to 1649.

From that time until 1789, the art of printing barely satisfied the wants created by its invention, especially towards the latter part of the time which preceded the remarkable epoch of popular emancipation.

In spite of despotism, it laboured without cessation, lending its aid to the fury and violence of all parties; and the nearer the crisis approached, the more force and activity did it display.



CHAPTER VI.

STEAM.

AMONG the highly valuable discoveries, we must place that of steam, for by its means distance is annihilated, trade rendered prosperous, human labour saved, and a new importance given to the country. It is a curious matter to follow the progress of this discovery, which is, in a great measure, due to the children of our beautiful France.

Anthemius, an architect and engineer, under the Emperor Justinian, mentioned by Agathias, in his history, book iv., having lost a law-suit against his neighbour Tenon, resolved upon a singular species of revenge. He filled several large vessels with water, and closed them very tight: several pipes were attached to the covers, which decreased in size as they reached upwards. Fire being placed underneath, the steam escaped through the pipes in the covers, and not finding a free vent above, shook the ceiling and the rafters of his own house, and that of Tenon, to such a degree, that the latter left it from fright.

The power of steam was then known at that time; but the application of it, for want of means, was never directed to useful purposes. Nevertheless, in an article of M. Arago, in the *Annuaire des Bureaux des Longitudes,* for the year 1829, we read that, one hundred and twenty years before Christ, Hero, of Alexandria, called the Old, invented an apparatus presenting

the first application ever made of steam. It bore the name of *spiritalia seu pneumatica,* and is called a reaction machine.

Under the reign of Louis XIII., a man conceived the project of making use of steam, as a motive power, on an extended scale; but his genius experienced an oppression of a terrible nature. If Cardinal Richeliue is mentioned in history as a capable minister, we must not yet forget that there were many victims to his pride and obstinacy, whose sufferings have tarnished his reputation for skill, and shed a bloody halo round his head.

The following is a letter addressed by Marion Delorme to Cinq Mars, the young man who entertained the silly project of overturning the cardinal minister:—

My dear D'Effiat:—Whilst you are forgetting me, at Marbonne, absorbed in the pleasures of the court, and of opposing M. le Cardinal, I, according to your expressed wishes, am doing the honours of Paris to your English lord, the Marquis of Worcester. I take him about, or, rather, he takes me about, from one curiosity to another. Choosing always the most sad and serious, speaking but few words, listening with great attention, and fixing his large blue eyes upon every one of whom he asks a question, as if he could see into the depths of their souls. He is never satisfied with the explanations he receives, and does not look upon things exactly as they are shown to him. For instance, when we visited the Bicêtre, he pretended to see marks of great genius in a crazy man, whom, if he were not raving, I am sure your Englishman would have taken to London, if possible, and listened to his nonsense from morning till night. As we crossed the yard filled with these creatures, I was half-dead with fright, and leaned against my companion. Suddenly an ugly face appeared behind the bars, and a hoarse voice exclaimed:—

"I am not crazy. I have made a discovery which will enrich the country that so violently opposes it."

Scene at the Bicetre.

"What is his discovery?" I asked of the man who showed us over the place.

"Ah!" exclaimed he, shrugging his shoulders, "something very simple, which you would never guess: it is the use of steam."

I burst out laughing.

"His name," continued the keeper, "is Solomon de Caus. He came from Normandy, four years ago, to present a memoir to the king, on the subject of the marvellous effects to be obtained by his invention: according to him, machinery could be moved by it, carriages propelled, and numerous other wonders produced. . . . The cardinal sent away the fool without listening to him. But De Caus, undiscouraged, followed him from place to place; so that Richelieu, tired of him, had him shut up

in the Bicêtre, where he has now been three years and a half, and where he tells every stranger, as he did you, that he is not crazy, but that he has made a great discovery. He has even written a book on the subject."

And he handed us a book. Milord Worcester took it, and after reading some pages, said,—

"This man is by no means crazy; and in my country, instead of shutting him up, we would have made his fortune. Bring him here: I wish to question him."

He returned from this conversation with a sad countenance.

"He is indeed crazy now," said he, "misfortune and captivity have destroyed his reason for ever; you have made him crazy; but when you put him in this dungeon, you placed there the greatest genius of your time."

Hereupon we took our leave, and since then he can only talk of Solomon de Caus. Adieu, my dear and faithful Henry; come back soon, and in the mean time be not too happy there, to preserve a little love for me.

Marion Delorme.

The book shown by the keeper to the Marquis of Worcester, was, no doubt, that published by the unhappy Solomon de Caus, in 1613, by the title of *Considerations of Motive Forces with various useful Machines.*

The idea of raising water by means of the elastic force of steam, belongs then to Solomon de Caus. Forty-eight years later, the Marquis of Worcester endeavoured to appropriate it to himself.

Side by side with the name of De Caus, stands that of Papin, the first who constructed a machine in which steam, under a high pressure, raised itself into the air after producing the desired effect. The atmospheric machine of the Englishman, Thomas Newcomen, with the exception of a few trifling particulars, is precisely the same.

The inventor of the steam engine with pistons, Papin, was the first man who perceived that steam furnished a simple means of creating a vacuum. He was also the first who thought of combining the action of steam with its powers of condensation.

He also proposed steam as a means of propelling vessels forty-two years before Jonathan Hull, whom the English consider as the inventor.

CHAPTER VII.

AUTOMATA.

BESIDES the happy results obtained by the steam engine under the reign of Louis XV., mechanism of another kind was carried to a height which it is difficult for even the imagination to reach. I speak of Vaucanson and his wonderful automata.

From early infancy Vaucanson gave signs of a rare intelligence. Brought up by a mother, the occupation of whose life was her devotion to him, he was in the habit of accompanying her on Sundays to pay visits.

On one of these occasions the young Vaucanson amused himself with examining, through the cracks in a partition, the mechanism of a clock in an adjoining room. It was the first time his attention had ever been directed to the subject, and he applied himself to the study of it. The following Sunday, he took care to provide himself with a pencil, and in copying what he saw of the springs, he succeeded in understanding their plan. A few days afterwards, he constructed one of wood, of which the mechanism was very exact. Soon after, giving himself up to all the warmth of his imagination, he made two little angels, who moved their wings, several priests, &c., for a baby-house chapel.

Whilst he was still young, being at Lyons, and hearing that a meeting was to be held for the discussion of a plan for furnishing the whole town with water, he set himself to work; but when he had finished his labours, timidity prevented him from offering the result to the meeting. Coming back to Paris after some months' absence, he was delighted to find that the plan of what is there called the *Samaritaine*, was the same as his own. This convinced him of his powers, and inspired him with courage, a faculty in which he was naturally very deficient. He gave him-

self up entirely to the study of this subject; and after three years, constructed a little figure of wood, which played the flute with astonishing precision.

This excited great admiration; and it is said that his servant, upon first beholding it, fell on his knees, believing his master to be inspired.

Some time after, he exhibited a tambourine-player; two geese which dabbled on the ground, looked for corn, and, picking it out of a trough, swallowed it; and, by an internal arrangement of wheels, the corn was triturated till it was entirely decomposed. Vaucanson also discovered a means of imitating the animal digestion in a remarkable manner.

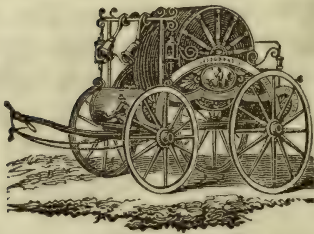
In 1740, the King of Prussia, who endeavoured to attach remarkable men to his court, made offers to Vaucanson, who however preferred remaining in his own country. Afterwards, attached to Cardinal Fleury, the inspection of the silk manufactures was intrusted to him. In this situation, which he had not sought, and which he owed to the superiority of his talents alone, he brought to perfection an improved method of preparing silk. In a journey made by him to Lyons, some ignorant workmen followed him, threatening to kill him, for diminishing the value of the labour of their hands, by the introduction of machinery.

Moved by a feeling of revenge, Vaucanson constructed, in a very short time, a machine, with which an ass executed a piece of flowered stuff.

He made an asp, which imitated all the movements, as well as the hissing of the animal, and which was designed for the representation of Marmontel's Cleopatra. He also undertook a mechanism to imitate the circulation of the blood, in which Louis XV. took much interest; but he abandoned the work, on account of its extreme slowness of progress. Voltaire, sharing in the feelings of admiration demonstrated on all sides for this really remarkable man, has justly compared him to Prometheus,

who snatched fire from Heaven to animate the work of his hands.

The seventeenth century, notwithstanding its military disposition, had yet time to harbour some vast ideas. Industry, wisely protected, acquired power, and added greatly to the revenue of the country. Versailles, heretofore scorched by the heat of the sun, now received the necessary water, by means of the Marly machine. Rennequin Sualem appeared, and Versailles assumed a new aspect of prosperity and well-being. Honour to the carpenter of Liege!



CHAPTER VIII.

RIQUET'S CANAL.

TWO years before, a project not less extraordinary in its conception, nor less useful, was put in execution: namely, the Languédoc canal, invented by Pierre Paul Riquet de Bonrepos.

The junction of the Mediterranean with the ocean, had been proposed under Francis I., but abandoned. Under Charles IX. it was again proposed; but civil war diverted the public attention from it. Henry IV., after having pacified France, occupied himself in ameliorating the precarious position of the kingdom, and among his plans was that of the junction of the two seas; but it met with insurmountable difficulties. In 1614, the deputies from Languédoc to the *Etats Generaux*, at Paris, applied to Louis XIII. for the execution of this work; but neither this, a proposition of Oribal in 1617, nor one of Cardinal Richelieu's in 1632, met with any success.

Nevertheless, according to the account given by the descendants of Riquet, the emulation of those who were anxious for it did not decrease, and plan succeeded plan. In 1633, Tichot, the royal engineer, and Bavau, master of the royal works in Languédoc, presented Cardinal Richelieu with a memorial for the construction of a canal from the Garonne to the Aude, near Barbonne, and from the Aude to the Mediterranean, rendering navigable the river Aude, and the ponds of Byrine, of Figean, and of La Nouvelle. In 1636, they went farther still; the Council of State made an agreement with Jean le Maire for the construction of this canal, who, however, was unable to accomplish it. In 1650, another engineer proposed to carry the waters of the Ariege to Saint Gabelle, at a distance of seven leagues from Toulouse, and to conduct them into a canal not

navigable, as far as under Pech-Darid, near the Faubourg Saint Michel de Toulouse; to dig a navigable canal afterwards, from the last-mentioned place as far as Naurose, passing by Castanet, Donneville, and Gemèt; and to continue this canal to Trebes, where it should join the Aude, which was to be rendered navigable as far as the sea of Nouvelle.

The nature of the soil, the apparent scarcity of water, and, above all, the difficulty of conducting it to the *Pierres de Naurouse,* elevated more than a hundred fathoms above the level of both seas, had caused these different projects to be considered impossible.

This gigantic project was received with admiration by Colbert, (whose vast intellect was always directed towards the improvement of the country,) and submitted to Louis XIV. by the Intendant General of the finances. This king, who took pleasure in imparting his puissant protection to all boldly conceived ideas, published an edict in 1663, on the 8th of January, commanding that the plan should be examined by the Commissaries, and by others chosen by the state. Nevertheless, a year elapsed before any thing was done; but at last, the meeting was fixed for the 6th of October, 1664.

From 1664 to 1666, the society were occupied in considering all the chances of success, and in the course of the last-mentioned year, the canal was begun. Riquet was now called upon to put into execution a project which preceding ages had looked upon as an imaginary one; but this laborious, indefatigable man, gave himself up to the glorious task which he had imposed upon himself. The eyes of all France were upon him, for many doubted the feasibility of the plan. Surrounded by jealous enemies, he marched proudly on, forgetting, as soon as he heard them, the many calumnies uttered against him. As the canal progressed, Riquet redoubled his efforts; but unfortunately, a few months before navigation was practicable in it, he fell sick and died, without enjoying the satisfaction of seeing his work completed.

His son, Mathias Riquet de Monrepos, finished it, and six months afterwards the canal was in a state of navigation.

The publisher of the Mercury of 1681, gave the following details concerning Riquet:

The canal uniting the two seas is completed. This is the more extraordinary, as it has always been looked upon as an impossibility; and although in preceding ages the want of it was recognised, no man ventured to undertake it. The late M. Riquet of Beziers, a man of fine intellect and great powers of penetration, resolved to spare no pains nor expense, in the accomplishment of this great work. Taught by his extensive knowledge in this branch of science, a knowledge acquired in the exercise of various important functions, that the project was a feasible one, he proposed the plan to Colbert; and the canal was begun in 1666, upon his answering for its success. To him alone, therefore, is all the honour due. When very near its completion, and confident in the anticipated triumph of the first trial of the canal, death snatched him from the delight of listening to his own praises. M. de Cassan says in his epitaph:

Here lies the man who overcame the difficulties of this bold design,
Who united the waters of the two seas,
Opened the bosom of the earth,
Levelled mountains,
Caused the waves to obey the commands of the king,
And who moreover
Never failed in truth,
As did Moses.
Nevertheless, their fates were somewhat similar:
One died in sight of the promised land;
The other, just before the completion
Of his canal.

Riquet made his own name celebrated by this undertaking. France has inscribed it on one of the brightest pages of her history. An idea of the importance of this canal may be gained from the following opinion expressed by Dupont de Nemours, a member of the council, in the year 5.

5*

The southern canal carries on a commerce of 50,000,000 a year: the merchants have an annual benefit of 5,000,000.

Land proprietors who make use of this canal for trading purposes, and who formerly had no means of transportation, or, at best, an inconvenient one, receive an augmentation of 20,000,000 in revenue, agricultural expenses included. By means of taxes, twentieths, &c. &c., the government gains possession of at least 5,000,000 of this annually, and of 500,000,000 in a century.

The year 1783 was a memorable epoch. The treaty which, by establishing peace between the two worlds, allowed a free navigation of the ocean in all directions, bears that date.

Benjamin Franklin.

CHAPTER IX.

THE LIGHTNING-ROD.

AS early as 1758, the New World was in possession of a useful invention of Dr. Franklin's; this was the lightning-rod.

The lightning-rod consisted of a rod of iron terminating in a platina point, and placed on the highest part of a building. Iron or brass wire, attached to the foot of it, descends the wall and buries itself in the earth. These rods are sometimes seen bent with the effects of the lightning, without the adjacent building being in any degree injured.

The first lightning-rod used in France, gave rise to a curious law-suit, in which a young lawyer appeared, who afterwards rose to great eminence.

M. de Vissery de Boisvalé, a great admirer of Franklin's discovery, placed one on his own roof at Saint Omer. The inhabitants of the village, beholding in this a machine for attracting lightning and causing their houses to be consumed by fire, applied to the magistrates to have it removed; and they, sharing

in the panic, ordered M. Vissery to take down the offensive lightning-rod.

At first this gentleman refused to obey until the court should have pronounced such a decree; but he was soon obliged to comply, for the neighbours, fully persuaded that their lives were in danger as long as it stood there, threatened to demolish it. Still, M. de Vissery did not consider himself vanquished: he intrusted his cause to M. d'Arras, a young lawyer, engaging him to plead in his defence and that of the lightning-rod. The defence was made with so much talent, and with a skill so remarkable, that the fame of the young lawyer soon spread far and wide, and M. de Vissery's triumph was complete..

The court reversed the decree of the magistrates, and the lightning-rod maintained its place.

Joseph Mongolfier.

CHAPTER X.

BALLOONS.

ON the fifth of June, 1783, the town of Annonay was in a state of extraordinary excitement. A man named Mongolfier had promised to exhibit a balloon ascension. At the appointed hour, a globe constructed of linen and paper soared into the air, and in ten minutes was at a height of two thousand metres, and at a horizontal distance of more than half a league, with an initial force of two hundred

and fifty kilogrammes. The globe or *ærostat* was large enough to contain twelve hundred cubic measures of rarefied air.

When this was ascertained at Paris, it excited admiration mingled with surprise. The members of the Academy of Sciences resolved to repeat the experiment at their own expense and on a larger scale.

Meanwhile, subscriptions were taken up on all sides for the construction of another balloon of vast dimensions. Charles, a professor of experimental physics, and Robert, a mechanician, were charged with the execution of this vast design. After a close examination of all Mongolfier's details, Mr. Charles substituted silk, covered with gum, for linen and paper. The gas employed by Mongolfier was produced by burning straw and wool under the balloon: this appeared to him so dangerous, that in its place he made use of hydrogen gas.

On the 27th of August, of the same year, less than three months after the Annonay experiment, an immense crowd assembled in the *Champ de Mars*, and waited impatiently for the ascension of Charles' and Roberts' balloon. The air resounded with repeated acclamations. The balloon, first balancing itself at the height of five or six feet from the ground, soared aloft, and in two minutes gained a height of one thousand metres, and, ascending rapidly to a prodigious height, alighted, in its downward course, at Gonnesse, a village five leagues distant from its starting-point.

On the 24th of November, a new *ærostat* ascended in the Park of La Muette. Pilâtre du Rosier, and the Marquis of Garlande, went, also, in a small bark attached to the globe, which bore Mongolfier's name. Hitherto, no human being had ventured upon this perilous voyage, although many poor animals had been forced to undergo its terrors.

On the 1st of December following, Charles and Robert renewed their bold attempt, and ascended from the garden of the Tuileries, travelling over a space of seven leagues in a few minutes. Upon beholding this spectacle, the crowd was seized

with an emotion of admiration and fear. According to a historian, men, women, and children fell on their knees and raised their hands to heaven in motionless astonishment, until the prolonged success of the ascension drew from them the most enthusiastic acclamations.

These ascensions were perilous, and required great caution. Charles' method was considered superior to that of Mongolfier. Nevertheless, the balloon of the latter had numerous partisans, at the head of whom was Pilâtre, who, a short time afterwards, venturing to cross, with a *Mongolfier*, from Dover to Calais, fell a victim to his own temerity; for the covering of the balloon took fire, and the unfortunate man, half-burnt, was precipitated to the ground, on the road to Calais, near Boulogne, and killed.

This melancholy circumstance gave a decided preference to the other balloon.

"Of what use are balloons?" asked some one of Dr. Franklin. "Of what use is a new-born child?" retorted the inventor of the lightning-rod.

CHAPTER XI.

PARMENTIER.

IN the year 1783, the alimentary arts received important additions. Potatoes had hitherto been considered dangerous as an article of food, and, according to the popular belief, would produce leprosy, and other dreadful diseases. Besides, they exhausted a good soil, and could not be produced in a poor one. Whilst the northern nations cultivated them, France rejected their use as pernicious.

Parmentier resolved to combat this prejudice in spite of the obstacles which he knew would oppose him. He applied to Louis XVI. for permission to plant potatoes on a piece of sterile ground, of about fifty acres, at Sablons. It was believed to be difficult to cultivate them; Parmentier wished to prove the contrary. His potatoes succeeded admirably. He had confided them to this arid soil, in the hope of proving, beyond a doubt, that he was in the right, and he awaited the time of flowering with great impatience.

Surprised at his own success, Parmentier culled the first flower, and hastened to Versailles, where he presented it to the monarch. Louis XVI. accepted the offering with a gracious smile, and placed it in his button-hole, regardless of the sneers of his courtiers.

Parmentier's efforts were crowned with success from that time, and the potato took the name of *parmentiere*.

"The potato," says Sir Joseph Banks, "which is now in common use, was brought to England by the colonists, sent by Sir Walter Raleigh, with Queen Elizabeth's permission, to discover and cultivate, in America, new countries not in the possession of Christians. It is probable that those vessels of Sir Wal-

ter's, which set sail in 1584, brought the potato to England on their return in 1586."

Once introduced into France, it was cultivated in gardens as a curiosity; but prejudice was, for a long time, stronger than reason. At the present day, the potato, at first called the *parmentiere* in France, is in constant use among the poor as well as the rich.

To Parmentier is also owing the propagation of maize and of chestnuts in France.

CHAPTER XII.

LAMPS.

"CHANCE," says Gaguet, "first taught men that certain substances, being plunged into oil, would burn slowly, and emit light. Such was the origin of the lamp."

The ancient lamps were far from satisfactory; furnishing only a dim light, and offending the senses and injuring furniture by the constant emission of clouds of thick smoke. Until the end of the last century, the wax candle was the only means of lighting a room without the inconvenience of smoke.

M. Charles Dupin explains, in the following manner, the defects of the ancient lamps.

In the composition of oil, hydrogen and carbon predominate. When it burns, hydrogen gas produces a flame, by absorbing $\frac{4}{8}\frac{3}{5}$ths of its weight of atmospheric oxygen. The carbon is partly consumed, but not so rapidly as the oxygen, when the combustion is not very intense. In evaporating to rise with the heated air, it soon falls again, and is deposited as black smoke upon every thing around.

Lamps were yet in their infancy, when Argand de Genève discovered, in 1785, a new method, of a nature to satisfy the wants of all classes, but especially those of mechanics, whose occupations require a steady and continued light. M. Charles Dupin gives the following description.

Argand entertained the idea of using cylindrical wicks, to the top of which the oil should ascend by means of a tube, or by the mere capillary attraction of the wick itself. The atmospheric air passing continually up the wick in two currents, one external, the other internal, these currents were rendered more rapid, by

a cylindrical chimney of glass concentrically surrounding the wick.

This problem solved, there remained but to make the application of it. Whilst Argand was just at the termination of his labours, Quinquet, one of his workmen, left his service, and immediately after brought out the improvement as his own. The public accepted it as such, and gave his name undeservedly to Argand's production.

Before concluding this part of the subject, we will say a few words on Chaillot's steam engine, and that of Gros Caillou. From 1762 to 1781, various projects had been formed for furnishing Paris with a supply of water, which was daily diminishing. Fountains were seen springing out of the ground on all sides, but this resource soon failed. The Perrier brothers had now for some time contemplated the adaptation of steam engines to this purpose. Their plans meeting with public approbation, they erected a large building on the Billy wharf, where, on the 8th of August, 1781, in the presence of the Lieutenant of the Police, trial was made of the first steam engine, with the utmost success; and in the month of July, 1782, the water obtained by this engine was applied to public uses.

Chaillot's engine only supplied the southern part of Paris with water; the Perriers established another on the left bank of the Seine.

From the short and incomplete sketch of different trades, given by us from the fifteenth century to the year 1789, it may be seen that mechanics and tradesmen in general took an active part in the progress of mind which distinguished that period. The proof of this is in the improvement made in every department of labour, and in repeated and valuable inventions; results victoriously attesting the intelligence which produced them, and forming an entire and peremptory refutation to the silly opinion of pride, ignorance, and thoughtlessness; namely, that the sole merit of the mechanic arts consists in an acquired sleight of hand.

The interesting details upon which we are now about to en-

ter, concerning the still greater advances made in these arts from 1789 up to the present day, will throw a still clearer light upon this truth. Revolutions have this advantage; that, if they arrest the march of industry for a time, they give it in the end a vigorous impulse, driving it forward with giant strides. If they were not so disorganizing in their nature, we would call them an essential condition of the social state. For, take any man you meet; let him lead a calm and uniform life; restrain him within certain limits; allow him no freedom of thought; and what will be the result? This man, losing all activity of mind, will fall into a state of apathy. On the other hand, allow a man to follow the dictates of his own intelligence, and behold the difference! The former, subdued and restrained, is a *slave;* the latter, with head erect, feels himself a *freeman;* and it is freedom alone which engenders improvement,—it is freedom alone which has given rise to marvellous inventions,—to everything, in fact, which does honour to the genius of man.

CHAPTER XIII.

CHEMISTRY.

A COMPLETE regeneration of social order was the result of the Revolution in France; and the dominion of science shared in the happy effects resulting from a commencement so bloody and disorganizing.

Chemistry had begun to discover the secrets of nature; in fact, many arts practised for several centuries had chemistry for their basis. At the beginning of the last century, Stahl had established a vast system of some authority in the learned world, although in some respects a false one. Other chemists of rare talent, such as Priestly, Black, Cavendish, Macquer, Scheele and Rouelle, applied themselves with ardour and diligence to the study of this subject; but their isolated efforts, far from tending to unity, only propagated a sort of scientific anarchy.

The bold project of collecting the imposing mass of known facts, and uniting them by a powerful tie, was one of great difficulty, and, says M. Gaultier de Claubry, " one which required a man of uncommon genius, one who should be indefatigable in labour, endowed with a tenacity in arriving at his ends, with a quick observation, and a determination to conquer the obstacles presented to him by the whole learned world; a man, in fact, to be awed by neither trouble, toil, nor expense. Such was Lavoisier, who struggled alone for ten years against the most violent opposition; nor was it until his enemies were forced to submit to the mass of proof collected by him in favour of his opinions, that his theory was universally adopted,—a theory destined to produce effects so extraordinary."

Modern chemistry owes its existence to Lavoisier, who established its basis, and gave it a methodical nomenclature. Formerly,

air and water had been considered elementary bodies; his experiments proved them otherwise. His analysis of the air, alone, had great influence over the revival of chemistry. If it be true that Cavendish discovered the secret of analyzing water before him, posterity ascribes to Lavoisier, the honour of having been the first to establish the exact proportion of the principles entering into the composition of this liquid.

The career once opened, the vigorous impulse given, science hastened to follow the steps of her talented master. "Remember," says the author of *Letters to Sophia upon Physics, Chemistry, and Natural History,* "remember the importance of Lavoisier's science. Every thing under heaven is connected with it. From it, the painter obtains his colours, the potter his earths, the physician his remedies, and the warrior his weapons. Other branches of science have a close relation to chemistry, for it creates mineralogy, reforms geology; and, penetrating deep into the earth, reveals to curious man, nature's profoundest secrets. Our food, our clothing, our arts,—gold, silver, iron, gunpowder,—every thing is the result of science, and science is the result of man's labour."

It is to chemistry, such as Lavoisier has made it, that we owe the bleaching of hemp and linen; the refining of metals; lighting by gas; sugar from beets; the improved manufacture of steel, and new modes of dyeing, remarkable for beauty and durability. Our manufacturing towns increased rapidly in riches, and Marseilles, the cosmopolite city,—Marseilles, the ancient Phocean colony, whose port is the rendezvous of fleets from all nations, found new sources of prosperity, in the chemical productions with which she began to supply the countries of the Levant, and the colonies.

Lavoisier, with all his genius, did not escape the horrors of the Revolution. Scaffolds were erected in every town, and the most illustrious men were the first victims. Rank, fortune, eminent merit, lofty virtues, were so many claims upon public hatred, and public hatred invariably brought in its train accusation and death. Lavoisier united all these qualities, and was, besides, a

fermier general, a class towards which the public rage was directed with remarkable fury.

Finding that his life was in danger, he took refuge in an asylum prepared for him by Mr. Lucas, the former door-keeper of the Academy of Sciences. But learning that twenty-eight of his associates were imprisoned in the revolutionary dungeons, his noble mind was unwilling to prolong the danger to which he was exposing his gracious protector, and he offered himself to the jailers.

In prison he abandoned himself with ardour to those labours which had already acquired him immortality. He was informed that he was to be brought to trial in a few days. At that disastrous epoch, *trial* was synonymous with *condemnation*. Lavoisier, moved by a love, not of life, but of his glorious profession, requested a short delay in order that he might complete a few experiments, and leave the inheritance of their results to the world. Fouquier Tinville, of execrable memory, made this reply:—"The republic has no need of chemists, nor of chemistry: the course of justice shall not be interrupted."

A few days afterwards *justice* followed her course, and France lost discoveries, according to the natural progress of science, still more valuable than those with which this great man had already endowed her. Lavoisier was a man of generosity and beneficence. In 1788, the town of Blois was threatened by a famine. As soon as he heard it, he placed a sum of 50,000 francs at the disposal of the municipal authorities of the place, without fixing any time of reimbursement. He was also the Mecænas of youthful talent, and delighted in assembling beginners in his well-furnished laboratory. It was there that Berthollet, Fourcroy, Chaptal, Vauquelin, and various others, afterwards renowned in science, gained their first knowledge.

During Lavoisier's imprisonment, the Lyceum of Arts, of which he was a member, sent a deputation to express to him the interest taken by them in the preservation of so precious a life; and to place upon his head a crown, as an emblem of the respect entertained for the services rendered by him to his country.

CHAPTER XIV.

PROGRESS OF THE ARTS—WORKS IN IRON.

IN the last part of the eighteenth century, although some of the mechanic arts remained stationary, others advanced without interruption.

Among these, we must mention the making of locks, a subject upon which we have already spoken, and one which is the more important, as it embraces various modes of working in iron, and the construction of the greater part of the tools employed in other arts.

In the last fifty years, the art of working in iron has arrived at great perfection, as may be seen in the labours of Destriches, Damour, and Gerard. This last, in 1770, presented to the Academy of Sciences, a canopy of iron supported by four columns, above which arose ornaments surmounted by a glory, all of the same metal; a piece of work which met with great admiration.

In former centuries, workers in iron attained some degree of

skill, as may be observed on the two side-doors of our ancient cathedral of Paris. The ornaments are composed of rolls, in cast iron, in the Grecian taste of the *Bas Empire,* and are attributed to a celebrated workman named Biscornet. We might, also, direct attention to the iron grating which connects the two wings of the Palace of Justice, a work certainly not wanting in merit, although of a heavy order, and not in the best taste.

From what we have said on the subject of locks, it appears that the Lacedemonians and the Egyptians were well acquainted with this branch of industry.

In 1699, the celebrated Papin, the inventor of the steam engine, fabricated a lock of so singular a construction, that the most skilful locksmiths were puzzled to open it, even though the key was given them, and although the inventor locked and unlocked this marvellous instrument repeatedly in their presence. Since then, a number of ingenious locks have been invented. What is called the safety lock dates from 1791; that is to say, it was not until then that it was made as cheaply as other locks.

The inventor of this lock was Benoit Sabatier. The Academy of Sciences, after having examined the labour of this lock-mechanician, decided that the idea was entirely novel, and the lock very superior to any other hitherto constructed or imagined. Some years afterwards, in 1799, another locksmith, Henry Kock, of Paris, gave to the public several new locks, of his own invention, entirely different in structure from former ones, and which were said to resist all attempts of thieves and house-breakers. But although no doubt very good, these locks were not all they promised to be; for the last-mentioned advantage has, unfortunately, been found to be easily overcome by means of taking impressions with wax. "No problem," says M. de Moleon, "has so much exercised the mind of man as that of assuring the safety of locks. For this purpose, guns, pistols, bells, &c., have been attached to them; but the general remedy, and the one most in vogue, consisted in rendering them as difficult and complicated as possible."

CHAPTER XV.

BRÉGUET—CLOCKS, &c.

THE science of mechanics applied to clock-making, reveals new wonders; and it is worthy of remark, that natural philosophy is a powerful auxiliary of this art, and that, by its assistance, we shall soon reach a degree of perfection in clocks never to be surpassed. We are about to speak of a clock-maker of the present day, whose renown has spread over all Europe.

Bréguet was born of one of the numerous Protestant families compelled, by the edict of Nantes, to leave France. Neufchâtel, in Switzerland, was his birth-place; and, among the ideas early impressed upon his young mind, that of the ruin of his family, and the necessity he was under of providing for himself, were predominant: nevertheless, no favourable augury of future eminence arose from his early indications. At school, he appeared hopelessly stupid, and his masters agreed that he was deficient in intellect. His father-in-law, a clock-maker, endeavoured to teach him his trade, but the young man received his instructions with great repugnance. But being sent to a clock-maker in Versailles, he began to take an interest in the art; and his intelligence, by means of studious perseverance, developed itself. When the time of his apprenticeship was expired, and his master was expressing the satisfaction his industry and good conduct had given him, he was surprised at meeting with the following answer:—

"Master, I have a favour to ask of you. I am sensible that I have not employed all my time to the best of my ability, in

your service, and I wish to be allowed to work three months more, under you, without salary."

This request established a friendship between the master and the apprentice; who, when he left him finally, found himself, by the death of his parents, charged with the support of his elder sister. Nevertheless, feeling a strong desire to complete his education, he was aware that a knowledge of mathematics was indispensable to the perfection of his art. His courage carried every thing before it: he laboured without relaxation for himself and his sister; and yet found time to listen to a course of lectures, delivered by the Abbé Marie, at the Mazarin college. The professor observing the punctual assiduity of the young clock-maker, made his acquaintance, and was soon united to him by a strong friendship, which contributed much to the future advancement of the pupil.

His ideas expanded, his labours acquired more precision. A new horizon seemed to open before him.

When the French Revolution broke out, Bréguet had already founded the establishment which afterwards produced so many master-pieces of mechanism and clock-making. His reputation was increasing under the most honourable and flattering suffrages.

A watch of his make fell into the hands of the celebrated English clock and watch-maker Arnold, who examined it with astonishment. The simplicity of the mechanism, and the perfection of the work, filled him with admiration; he could not believe that any thing could be so well executed out of England; and yielding to the love of his art, he immediately set out for France for the purpose of seeking Bréguet's acquaintance. Arrived in Paris, there immediately arose a strong friendship between these two men; and Bréguet, to give a proof of his esteem and affection for Arnold, desired him to take his son with him to England and instruct him in their art. This is a beautiful example of modesty and of confidence, worthy of the imitation of many men of talent, so often divided by jealousy and a spirit of rivalry.

Bréguet's first establishment was destroyed by the revolutionary hurricane, and he himself forced to fly from the country. During his absence, the generous assistance of friends enabled him to continue the exercise of his profession, together with his son. At last, after an absence of two years, he returned to Paris, and opened a new establishment, at the head of which he remained with daily increasing prosperity until 1823, when he died.

Bréguet was a member of the Institute, as well as Ferdinand Berthoud, his worthy rival. He had been successively appointed marine clock-maker, and a member of the *Bureau des Longitudes*.

For the just appreciation of Bréguet's labours, we can do no better than to borrow the pen of the learned and judicious critic, M. Charles Dupin.

"This celebrated clock-maker," says he, "whose discoveries do honour to the period whose history we are relating, has brought all parts of his art to perfection; nothing can be more delicate, nor more ingenious than his detached escapement. He invented also an escapement called *natural*, where no oil is required, and in the mechanism of which there is no spring. Another still better and finer mechanism is that of the duplex escapement, which also dispenses with the necessity for oil; and as the successive impulses are all given in the same direction, the balance necessarily makes two vibrations for each impulse.

"Portable marine watches or chronometers may without injury experience any change of position, except that caused by the rolling and pitching of a vessel. Bréguet conceived the bold plan of enclosing the whole mechanism of the escapement and the spring in a circular envelope, which performs a complete revolution every two minutes. By this means, the inequalities of position are, as it were, equalized in this short space of time. The machine undergoes all irregularities of position, and compensates for some by the others. This compensation takes place

either when the chronometer is subjected to a continual motion, or held immoveable in an inclined or direct position.

"Bréguet has done more; he has discovered a method of preserving the regularity of his chronometers, even in case of their being struck or experiencing a fall to the ground. Such is the effect of his *parachute*. An English observer, General Brisbane, possessing one of these chronometers, subjected it to great trials by constantly wearing it on horseback; and during several long voyages, in sixteen months the greatest variation was of only a second and a half, that is to say, the $\frac{57}{600}$ part of a diurnal revolution.

"At the time when Bréguet obtained this great result, the English parliament, with British generosity, offered a reward of two hundred and fifty thousand francs to the artist who would make a chronometer for ships, the daily variation of which should not exceed two seconds. No one had gained this prize when Bréguet exceeded this limit, as above stated."

"I am glad," adds Dupin, "to be able to state that Bréguet began as a simple workman; and, even when he became eminent, was always a firm friend to young men of his own trade, and was able to assist many of them from the deep interest he took in their welfare."

His watches were remarkable for their precision, even when reduced to the smallest size, according to Lepine's method. He used, instead of fusees, a set of springs whose moderate and continual force acts without complication and with less friction. "Great talent was required for the invention of the fusee," says a learned geometrician, a good judge of this subject, "but greater for the suppression of it."

CHAPTER XVI.

WORKING IN WOOD.

THE end of the last century beheld great improvements in the arts of carpentry and joinery, those two domiciliary arts, which consist in cutting, shaping, and joining pieces of wood, in order to make them serve in the construction of houses and other edifices. Geometry is requisite to excellence in either of these arts. The illustrious Monge thought it necessary to describe the art of carpentry, in his Treatise of Descriptive Geometry; and said, that if circumstances had made it necessary for him to devote himself to any trade, he would have chosen that of a carpenter.

The annals of industry have preserved the memory of the cupola of the *Halle aux Farines* at Paris, which was consumed by fire, in 1802.

This cupola was a master-piece of art. Its construction was the invention of Philibert Delorme, a celebrated architect under Henry II. His plan had great advantages, especially in lightness of construction, and economy of wood; for it is possible, in this manner, to raise a very large roof with small logs. The greater number of Parisian historians are silent respecting the name of the builder of this cupola; others attribute all the honour to Legrand and Molinos, architects. We shall take it upon ourselves to rectify these errors, and render justice to whom it is due. In fact, the work was so admirable a one, that it is wrong to allow the artist's name to remain in obscurity. The cupola was ornamented by twenty-five rays of panes of glass, producing a fine effect. The eye beheld with astonishment this immense vault of one hundred and ninety-eight feet high, three hundred and seventy-seven in circumference, and one hundred feet from the

floor of the pavement to its summit. It was impossible to conceive how the dome was sustained, divided thus between wood and glass, and apparently less than one foot in thickness.

The following is the origin of the construction of this cupola. The grain trade had for a long time been confined to the circular galleries of this edifice, whilst the central open space remained unemployed. At the time of the fêtes given in honour of the birth of the Dauphin, son of Louis XIV., this space was covered by an immense awning, presenting by the light of the illumination a beautiful appearance, which made a strong impression on the imagination of two young architects, Legrand and Molinos, recently returned from Rome. The authorities conceived the project of substituting for the awning, a permanent roof of wood. "But," as M. Boileau remarked, from whom we borrow these details, "the roof must not be too heavy for the old foundations." The public embarrassment was very great; how was it possible to find a builder capable of executing so difficult a task? One of those present at the deliberation of the architects, expressed his opinion that there was but one person in Paris able to realize such a project. This was the builder, Roubo, author of a skilful treatise on the subject of building. Upon this, the architects went to M. Roubo, and presented their request to him. He asked to delay giving an answer until the next day, when he made known his determination to undertake the construction of the cupola; but on condition of entire freedom to follow his own plans. This being agreed to, Roubo set to work, and renewed the plan employed by Philibert Delorme in building the Chateau de la Muette, which consists in substituting for large pieces of timber work, deal boards placed horizontally in roofs of all dimensions.

M. Boileau goes on to say, that,

"After struggling with difficulties of various natures, and assisting with his own hands in the formation of every piece of wood in the cupola, aided by Albourg, a carpenter, and the worker in iron, Raguin, who executed the iron lantern on the

top—after five months of labour so well directed as not to risk one human life, the great work was completed on the 31st of January, 1783. It presented a diameter of thirty-nine and a half metres or feet, a difference of only four feet from the diameter of the Pantheon at Rome. When the centres were taken down, Roubo, full of confidence in his system, insisted upon standing under a cornice of the platform, in order to examine the roof closely, and observe if it shook when left to its own resources. No one would share with him what every body considered a great danger. The props were removed amid the acclamations of the people, and the intrepid Roubo was assured of the complete success of his undertaking. He was borne in triumph on the shoulders of the admiring citizens, the crowd pressing on all sides to gain a sight of the man to whom they owed a construction so new and so useful.

Roubo, on this occasion, as well as on all others, showed himself to be as disinterested as he was skilful, renouncing what he might have claimed as originator of so great an enterprise, and accepting only the sum agreed upon as a remuneration for directing the work. Raguin praising his own lantern one day to him, Roubo replied, "Don't mention it; if I were only in your line, I would have made the whole cupola of iron." An idea realized twenty-five years afterwards.

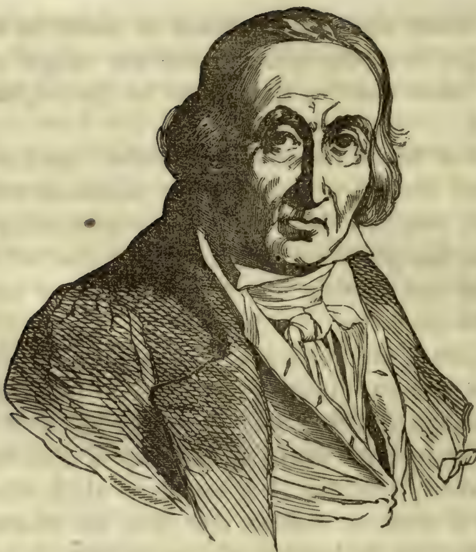
Roubo's success and reputation are a new proof of the influence of industry and application. Son of a journeyman-builder, devoid of intelligence or education, he had been left to himself at an early age. Nevertheless, endowed with a strong desire to raise himself above the circumstances in which he was placed, and conscious that improvement alone would do this, he applied himself diligently to study, although many difficulties stood in the way. The little money given him to buy food, was for the most part laid out in the purchase of books and models for drawing. The harshest privations were unheeded by him, if he could but procure books. When he began to work at his father's trade, he was still so poor, that when he sat up during

the long winter nights for purposes of study, he could not afford to pay for a lamp or candle, and was obliged to pick up pieces of tallow and fat, thrown out by the neighbours, and burn them.

Such ardour did not remain long unfruitful. He was observed by Professor Blondel, a nephew of the celebrated architect of that name; and, from that time, he had a guide and a support. After giving him gratuitous lessons for five years, and otherwise encouraging and assisting him, Blondel had great cause to be proud of his pupil.

The cupola of the Halle aux Farines is no more, but other monuments remain to attest his talent, such as the massive staircase of mahogany in the *Hotel Marbœuf*; the vault over the *Halle aux Draps;* and above all, his "Art of Building."

The vestitiary arts, that is to say, those which relate to the fabrication of stuffs for clothing, now claim our attention. We must premise with the mention of an improvement in mechanics, to which the city of Lyons, so celebrated for her manufactures, owes in some degree the regeneration of her industry.



Jacquard.

CHAPTER XVII.

MANUFACTURING IMPROVEMENTS—JACQUARD.

"PREVIOUS to the revolution," remarks M. Charles Dupin, "those branches of art which provided the lower classes with good and comfortable clothing, were in a state of deplorable wretchedness. Those alone had advanced which furnished the higher classes with articles of luxury. The Revolution put a stop to this bad state of things by attacking and dispersing the elegant arts without pity. Riches became, at that period, a crime; so that the higher classes often concealed their opulence under an outward garb of poverty. Workmen were driven from their employment, upon the ruin of their masters; manufacturing towns, such as Lyons, were stripped of

what had once been their greatest source of riches and prosperity. Costumes experienced an universal change; the court dress was replaced by the *carmagnole*, and the French hat by the cap of a freed slave; silk gave way to woollen, and linen to cotton; powder was banished from the hair by famine and dread. Such were the few good effects of the reign of terror."

But this could not last long. To a nation such as France, luxury is indispensable; we may say it is a condition of its existence. In the early part of the reign of the Directory, the saloons of the capital were again brilliant with the splendour of dress and furniture, in which a display of riches was carried beyond the bounds of good taste and modesty. The courtiers of the new race were not distinguished by the exquisite politeness, nor the knightly grace so universally admired in the times of the old French monarchy; but, incapable of copying the manners, they attempted a silly imitation of the old costumes.

Meanwhile, the arts were little by little revived.

Jacquard, of Lyons, born in the humble ranks of workmen, invented the admirable improvement which bears his name, and which will always keep him in remembrance.

His father was a master-workman in silk, at Lyons, where, in the year 1752, the son was born. The sight of one of Vaucanson's wonderful machines, revealed to him the nature of his own genius. His first endeavours were received with sneers and jests; a common fate with men of talent. But obstacles only redoubled Jacquard's industry. Supported by the aid of several independent workmen, he succeeded in establishing some improvements of his own invention, for winding and weaving silk; but here new difficulties, new impediments, and we may also say, new dangers, threatened him. "A second Galileo," says one of his biographers, "Jacquard was persecuted by his fellow-citizens; who, instead of encouraging him, loaded him with reproaches, and even went so far as to threaten his life. They looked upon him as an ambitious character, whose object was to injure his fellow-workmen, and to ruin labour, and bring

poverty upon their heads by his invention; so that the unfortunate man, terrified and discouraged by the treatment he met with, and despairing of being able to overcome their prejudices, shut up his admirable mechanism in a garret, and waited till more fortunate days should give him an opportunity of meeting with justice."

The above statement is strictly true. The new invention was publicly destroyed, and the life of the inventor three times endangered. The great advantages attendant upon this important discovery were obstinately overlooked; for no one had any regard to the diminution of hands employed, to economy in workmanship, or to the alleviation of the sufferings of some of the labourers, which, in one process, were very severe. A malicious jealousy only saw, in his ameliorations, a loss of salary for the greatest number, and was careful to spread this opinion. Nor did these prejudices cease until France began to feel the effects of competition with other countries, when Jacquard's method was adopted; and at the present day it is the only one in use at Lyons.

Jacquard, in his improvement, combined two principles of mechanism, which, employed separately, tend to the same object, but without success. Formerly, the threads which were to be lifted up together to form the figure of the stuff, were moved by cords pulled by a child, to whom the weaver was obliged to point them out. The new method remedied this inconvenience by a regular mechanical process, aided by a moveable pedal.

The Jacquard invention, although in common use at Lyons, was not generally known until long after, and at the exhibition in 1801, it only obtained a bronze medal and a slight notice; nor was full justice done to it until eighteen years later, when, surmounting all difficulties, neglects, and criticisms, it gained the victory over the old laborious, extravagant, and unhealthy methods. The commissioners in 1819 decreed to Jacquard a gold medal, and, still further, the cross of honour.

This process is now used not only for silk, but for all varieties of woven stuffs.

Jacquard was remarkably modest and disinterested; omitting to derive any advantage from the various patents he obtained. He was the inventor of a machine for making fishing-nets, but which never brought him any profit, owing to his negligence. When mention was made to him of those who were rapidly increasing their fortunes by means of his inventions, he would reply,

"I do not complain; it is enough for me to have been useful to my fellow-citizens, and to have a claim upon their esteem."

CHAPTER XVIII.

OPTICAL INSTRUMENTS—PIANOS.

PARALLEL with the progress of science in other departments, were the improvements made in optical instruments. Before 1789, Europe procured all her astronomical instruments from England; France having no able artist in that line. Herschel, a Hanoverian, and a musician in a regiment,

was made director of an organ in Bath, where, after employing his leisure time for ten years in constructing gigantic and powerful telescopes, he discovered, not a new star, but the mobility of one hitherto ranked with the fixed stars. Such an event taught France the necessity for instruments proportioned to the advanced state of science. The engineer and musician, Lenoir, distinguished himself by still further improvements in this valuable branch. It was he who obtained the first prize at the exhibition in 1798, for portable reflecting circles.

At the subsequent exhibitions he was equally successful, receiving prizes for large astronomical instruments, amongst which was a fine Borda circle.

Sebastian Erard, in giving France that fine musical instrument, the piano, created an important branch of commerce, and obtained for his own name an eminent place among those of illustrious mechanics.

Before his fortunate importation, the spinnet and the harpsichord, with their harsh and discordant sounds, were much in vogue. Erard's pianos altered the nature of musical harmony; and, according to M. Castil Blaze, the harpsichord was consigned to the garret, there to remain until needed for fuel.

Sebastian Erard, born at Strasbourg, in 1750, was originally destined to architecture. Fortunately for the lovers of good music, reverses in business obliged him to become a mechanic. Arrived in Paris, at the age of sixteen he apprenticed himself to a harpsichord-maker, in whose service he soon became a skilful workman.

Upon leaving this place, another harpsichord-maker, acquainted with the young man's remarkable talent, made him a proposal to execute an instrument of different construction from the common harpsichord; but by a private arrangement, the master's name was to appear upon it. When it was completed, the amateur who purchased it, delighted with its excellence, returned to ascertain if the harpsichord-maker was the true originater of the improvements, and asked numerous questions concerning the in-

Erard and the Duchess of Villeroi.

ternal mechanism. The man, taken by surprise, was at a loss how to reply, and was in the end forced to admit that it was the work of young Erard.

Erard's reputation spread rapidly. The Duchess of Villeroi, a patroness of the arts, took the young artist under her protection; and it was at her house that he constructed his first piano. This instrument, recently invented in Saxony, by Silberman, was then almost unknown in France. The Duchess of Villeroi wished to have one, and also that it should be of French make; she asked Sebastian Erard if he thought he was able to make one. This was a sort of challenge, which the artist, confident in his own powers, accepted without hesitation, and the piano was soon completed. It was thus, says a biographer, that a great lady and a young artist introduced this valuable musical instrument into France.

Listened to in Madame de Villeroi's saloon, where all the talent of Paris was accustomed to assemble, it produced a great

impression, and a scientific comparison being made between it and a German instrument of similar construction, in a neighbouring house, the preference was given to the French one.

Sebastian Erard, together with Jean Baptiste Erard his brother, formed an establishment which succeeded admirably from year to year. Their pianos spread not only over France, but also into the Netherlands, and some parts of Germany. In the year 1799, a commissioner in Hamburg sold more than two hundred of Erard's pianos.

Amongst other improvements by Erard, was that of adapting all pieces of music to voices of moderate power; and he entertained the idea of rendering the key of the piano moveable in either direction to the extent of half a note, a whole note, or a note and a half. This ingenious contrivance was first tried upon a piano made for Marie Antoinette. It was also on this instrument that he made the first trial of the *orgue expressif*, in which, by the prolonged pressure of a finger, the sound was diminished or increased at pleasure like the inflexions of the voice.

"I have," says Gretry, in his Essay on Music, "played five or six notes on an Erard organ which had been made susceptible of tones; the more I pressed, the more the sound increased; and, in softly raising my finger, it diminished. It is the philosopher's stone of music. The nation ought to build a very large organ of this kind, and reward Erard richly, for he is the most disinterested man in the world."

Gretry wrote these lines in 1812, a time when Erard's genius was by no means at its height. The beautiful and difficult invention of the harp with two pedals added a brilliant leaf in his laurel crown.

He not only improved the form of this instrument, giving it more elegance, but also tripled the richness of its sound by means of pedals and levers, skilfully combined to correspond to the same sounds of the octave, on different strings.

What is the reason that the harp, with its harmonious vibra-

tions, its melancholy charm, its angelic sweetness, is so much less studied than the piano? M. Charles Dupin gives the following solution of this problem:—

"The harp is a very costly instrument, and one which is easily deranged in the midst of playing, by the continual breaking of the strings; and has besides the disadvantage of giving a lady a somewhat theatrical position, bringing into relief the beauties of form and motion, displaying arms, hands, feet, and figure, even where, as occasionally happens, it would be better to throw a veil over some of these. The fingering is also much more difficult than that of the piano, so that every year the harp is less and less studied, and gradually disappears from instrumental concerts. It is besides very inferior to the piano as an accompaniment to the voice, being much more penetrating and vibrating."

However this may be, Erard's fame remains untarnished. The success of his harp with two pedals, was particularly great in London, where he directed a flourishing establishment, in spite of his being a Frenchman. Finally, his last and greatest work, his improved grand piano, completed his scientific reputation. He had obtained the gold medal at every exhibition of the products of French industry, and was the first musical instrument maker who obtained the cross of the Legion of Honour.

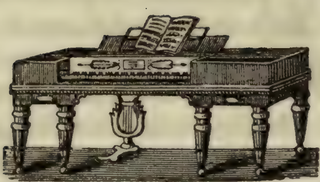
After his death, which took place in the month of August, of the year 1831, his workmen paid a solemn and touching tribute to his memory. A bust of Sebastian Erard had been taken by means of a subscription got up among them. The day devoted to the inauguration of this monument of respect was one which deeply affected them.

Erard possessed the rare quality of making himself beloved by all those employed in his service; sharing their labours and rejoicing in their improvement. He always spoke to them in tones of encouragement, and assisted them when in difficulties; not only by advice, but with his purse, which was always open to them. He gave pensions to aged mechanics, or such as were in extreme poverty; and carried his generosity to such a degree,

that he would aid those of his own trade in founding establishments on as large a scale as his own.

Apprentices are considered an ungrateful class; but good masters make good workmen; and if such a man as Erard were at the head of every manufactory, it would not be necessary to provide so many ameliorations in the moral training of the working classes.

We have spoken of Vaucanson's wonders. The end of the eighteenth century gave rise to new ones of the same nature, but more surprising still. Although mere works of curiosity, these have excited great admiration in all ages. Plato relates that Architas, of Tarentum, made a wooden pigeon which could fly; a circumstance easy of belief to any one who has seen Vaucanson's automata.



Mical destroying his own Works.

CHAPTER XIX.

AUTOMATA.

AMONG these prodigies of mechanism, there are, undoubtedly, some which excite admiration by the skilfulness of the deception only. We will mention one of them: the famous chess-player which made so much noise in 1783.

This was the work of Kempelen, counsellor of the finances to the Emperor of Austria. The automaton, dressed as a Turk, sat behind a sort of chest, three feet and a half high, which was on castors, and was rolled backwards and forwards in the presence of the spectators, and opened to exhibit the cylinder, and the wheels by which the arm of the figure was moved. This arm raised itself slowly, stretched itself out until it reached the piece proper to be played, opened its fingers, took it up, and transported it to the square on which it should be placed, and then slowly returning, rested upon a cushion. At every move made by the adversary, the automaton shook its head, its eyes glancing over the board, calling out "*Echec*" when necessary. If its adversary

made a false move, it would put the piece back into its place, with a shake of the head. It would also reply to any questions asked it, by means of a tablet, containing all the letters of the alphabet, placed before it, and upon which it would point out in succession those which formed its reply.

The greater the deception, the greater the number of dupes; for the human mind has a natural inclination for the marvellous. A machine may be so perfected by man as to have some qualities analogous to those of the body, but can never be endowed with a particle of intelligence. Prometheus alone snatched fire from heaven.

Albert Le Grand, a Dominican, and bishop at Ratisbon, constructed a head of brass which pronounced articulate sounds. Kempelen, mentioned previously, exhibited to the Academy of Sciences, an automaton which distinctly articulated several phrases: "Me ama;" "Aimez moi, Madame;" "Venez avec moi à Paris," &c. Kratzenstein put together another, imitating the vowels.

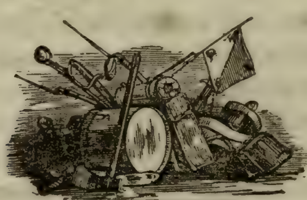
Afterwards came the Abbé Mical, who invented several automata, the sources of much wonder. He made a group of figures playing upon different musical instruments, and presented to the Academy of Sciences, two colossal brazen heads, which pronounced entire sentences in a distinct manner, in a strong and sonorous voice, very like that of man.

France had reason to be proud of Mical's ingenuity; but the government, in 1784, refusing to purchase his automata, the unhappy man, overcome with debts, and reduced to great poverty, fell into a fit of despair and anger, and destroyed them with his own hands.

These experiments, says a writer, have resolved a great problem; that of whether the human voice could leave the place assigned it by nature. A wheel and a lever are as far removed from a speaking head, as the stroke of a pen from a fine painting. Vaucanson confined his efforts to animals, imitating their motions and their digestion. Mical, Prometheus-like, raised his

aspiring hand to man, selecting for imitation his most brilliant and most complicated power. He perceived that the vocal organ in the throat was a wind instrument, having its keys in the mouth; that by blowing inwards, as in a flute, disconnected sounds only could be produced; but to articulate words, it is necessary to blow outwards. The air, in passing from our lungs, becomes sound in the throat, and this sound is divided into syllables by the action of the lips and tongue, aided by the teeth and palate. A continued sound would be a prolonged vowel; but, divided at different intervals by the tongue and lips, it gains a consonant at every division, and becomes modified into an infinity of articulations expressing all our various ideas. Upon this principle, Mical applied two keys to his heads; one a cylinder, through which only a limited number of phrases was obtained, but upon which the intervals between words and their prosody were correctly marked. The other key contained all the syllables of the French language, reduced by an ingenious method of the author's to a very small number. By means of a little skill and practice, the articulation might be made with the fingers as well as the tongue; and the rapidity, the repose, and the expression peculiar to the human voice when not under the influence of passion, given to these heads of brass.

If we may put faith in Montucla, author of the *History of Mathematics*, Mical's speaking heads were sold, but we hear nothing of the buyers. It can hardly be possible that a body of men intrusted with the interests of the state could have been so very negligent of the progress of science, as to omit to inquire into the fate of these curious automata.



CHAPTER XX.

THE TELEGRAPH.

FIRES, beacons, torches, and standards, were made use of by the ancients for despatching news to a distance with promptness. In the time of Polybius, signals were made with torches, and later still, by means of planks and boards: the want of magnifying glasses creating a necessity for very short distances between these beacons, which, after all, were only visible by night. Among the moderns, the first telegraphic essays known were those of Kircher, Kesler, Amonton, Gauthery, Guyot, and Paulian. But their methods, although more or less ingenious, left much to be desired.

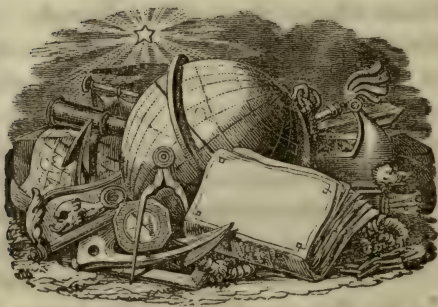
At last, Claude Chappe invented the telegraph.

This consisted of a beam which turned on a pivot in the top of an upright post, having a moveable arm at each of its extremities, and each different position in which the beam and its two arms could be placed at angles of forty-five degrees, afforded a separate signal, which might represent a letter of the alphabet, or have any other signification that should be agreed upon.

The first official trial of the telegraph was made on the 12th of July, 1793. Its success was complete; a despatch was transmitted to the distance of forty-eight leagues in thirteen minutes and forty seconds.

The mechanism of the telegraph is such, that it acts easily and rapidly; and, assisted by good telescopes and second pendulums, observations are made and messages communicated from one extremity of France to another, by means of secret signals unknown to chance observers.

The invention of the telegraph is particularly useful to government, which is thus advised of all that may be of importance. Such instruments are placed on elevated situations, at regular distances from each other, and supplied with telescopes. News is received at Paris from Calais in three minutes, by means of thirty-three telegraphs; from Lille in two minutes, by twenty-two telegraphs; from Strasbourg in six minutes and a half, by forty-four telegraphs; from Toulon in twenty minutes, by one hundred telegraphs; from Brest in eight minutes, by fifty-four telegraphs; from Bayonne in thirty minutes, through Tours and Bordeaux. Many individuals once obscure, have become very rich by skilfully taking advantage of the announcements of the telegraph. Gratitude should induce them to erect a monument to the memory of Claude Chappe.



CHAPTER XXI.

GALVANIC BATTERY—VOLTAIC PILE—MAGIC LANTERN—PANORAMA.

CHANCE gave rise, about the year 1789, to one of the most important of modern discoveries.

Galvani, a natural philosopher of Boulogne, was dissecting a frog, whilst one of his pupils was making experiments in electricity in the same room, and drew sparks from the conductor. He remarked, that suddenly the muscles of the frog, being exposed, gave signs of motion whenever the nerves came in contact with the scalpel, which acted as a metallic conductor. Galvani varied his experiments and dissected another frog, exposing the nerves which go down the spine into the legs, and wrapping them in a leaf of pewter, applied to this one of the two extremities of a compass or a pair of scissors, and touched with the other the surface of the leg or thigh of the frog. Every time this was repeated, it produced convulsive movements in the muscles, which were motionless when the process was repeated without communication with the pewter leaf.

Galvani, a man of great intelligence, beheld the existence of a new principle in this phenomenon, and originated the fertile branch of physics known by the name of Galvanism.

The convulsions observed by him in frogs were not permanent, and could only be produced by contact with an instrument formed of two metals. After numerous experiments, he discovered that a metallic communication must be established between the nerves and the muscles.

The galvanic fluid, Nature's most powerful agent in all her operations on the surface of the globe, was thus made known to man.

Shortly afterwards, Volta, another philosopher, repeated Galvani's experiments, and discovered that electricity was developed by the mere contact of metals; and conceived the fortunate idea of constructing what has since, from the name of the inventor, been called the *Voltaic pile*, which consists of alternate layers of zinc and copper, separated by pieces of moistened cloth (which is an excellent conductor). The quantity of electric fluid produced by the first contact of zinc, copper, and cloth, communicates itself to the second, and so on, increasing with great energy as it accumulates to the end of the pile. The chemical effects of this instrument are very remarkable: it decomposes water, oxides, acids, and all salts.

In the same year (1798), the philosopher Robertson exhibited a surprising and interesting novelty at Paris: an optical illusion, by aid of which, the natural magician, without sorcery, invoked spectres and frightful phantoms. This was the magic lantern.

We borrow the following description from the *Dictionary of Industry*:—

"You are ushered into a dark room hung with black, or where a sepulchral lamp gives a faint light. Before long this is extinguished, and the exhibition begins with a noise of rain mingled with hail, and on an illuminated wall at the other end, you perceive representations of Rousseau, Mirabeau, Voltaire, and other well-known personages. Fearful scenes are also introduced, such as a skeleton which raises itself from the ground and walks along; a tomb which opens, and is struck by lightning; a bloody nun with a lantern in her hand, who comes down a long gallery, &c., &c. This exhibition, so terrifying to the ignorant, was a source of curiosity and interest to the learned, who recognised in it the laws of catoptrics."

The eighteenth chapter of the seventeenth book of Porta's Natural Magic contains an account of the magic lantern.

At the same period (1799), a new species of painting, improved by optical illusions, captivated all Paris. It was a vast circular representation of objects, where the eye reached to a

horizon, and there being no limit, the illusion was complete. This was called the panorama, from two Greek words, signifying a view of the whole.

The canvass upon which the panorama is painted, covers the walls of a tower, three hundred feet in circumference. In the centre of the edifice a platform is erected, surrounded by a balustrade, and is destined to receive the public. The roof, in the form of a reversed cone, admits the daylight through an annular opening. A covering is placed over the heads of the spectators, casting a shade so that the greater part of the light falls on the painting, illuminating skies, trees, figures, and giving warmth to the various tints in the north, south, east and west, by means of the ingenious arrangement of these points of the compass in the interior of the edifice.

Upon first looking at a panorama, the eye is struck with the great number of apparently confused images; but insensibly, this impression wears off, each object assumes its proper place, and the effect is truly magical: you fancy yourself in the centre of a town, or a field of battle; the painting is no longer a piece of canvass, the work of art,—it is nature—living, active nature.

The invention of panoramas is due to Robert Barker, a portrait-painter in Edinburgh, who obtained a patent for it on the 19th of July, 1787. It was not until five years afterwards that he exhibited one in London, representing that city itself.

This new mode of painting was brought into France about the year 1799, by the American, Fulton, of whom we shall hereafter speak more at large.

A landscape-painter, of the name of Prévost, made the best and most extensive application of panorama-painting. That of *Paris* was the first exhibited by him, and in seventeen others afterwards offered to the public, his talents improved rapidly. The best were those of Rome, Naples, Antwerp, London, Jerusalem, and Athens. Whilst employed upon the panorama of Constantinople, he was attacked by the illness which caused his death, in 1823.

The following is Mr. Chateaubriand's testimony to the merits of this able and conscientious artist:—

"The panoramas of Jerusalem and Athens have been exhibited in Paris; the illusion was complete. I recognised streets and monuments, and even the little court where I myself lived, in the convent of Saint Sauveur. Travellers' stories will be less easily credited than formerly, now that foreign cities come to Paris to prove and disprove."

Prévost may be regarded as a faithful imitator of nature; for his drawings were taken upon the spot, and painted afterwards with a rare excellence. The different aspects of the country, the varied tints of the sky, the scrupulous exactness of detail, the perfect harmony reigning in all his compositions, endow them with uncommon beauty. His sky of Tilsit is not the sky of Jerusalem or of Athens. The smoky air of London, the city of fogs, is in perfect contrast with the sunny atmosphere of Naples. In the plain of Wagram, the smoke of artillery and musketry is perfectly distinguishable from that of burning villages, and clouds in the sky from vapours hanging over the Danube. The great painter, David, upon visiting one of Prévost's first panoramas, said to his pupils, "In future, come here to study nature."

CHAPTER XXII.

THE BALLOON AND PARACHUTE.

MONGOLFIER'S invention, which had opened a career through the air, was not a mere object of curiosity. The inventor's first idea was to employ balloons for military reconnoissance. In the beginning of the Revolution, an attempt was made to discover the motions of the enemy by this means. During the celebrated battle of Fleurus, bulletins attached to small flags were let down from balloons, giving the French general notice of the position and manœuvres of the enemy's army. A body of *aeronauts* was instituted to march in the train of the northern army. The illustrious Malesherbes, a sincere friend to arts and virtue, and a zealous protector of all that tended to augment the glory of France, took a deep interest in the efforts of the Mongolfiers. "I cannot express to you," said he to Boissy d'Anglas, "how delighted I am that this invention has been made in France instead of England, which would, before long, have given it to the world. I consider it a greater national honour than a naval victory."

The invention of the parachute gave a new interest to aerial voyages. Several natural philosophers claimed the honour of this invention; but the aeronaut, Garnerin, was the first who put it in practice.

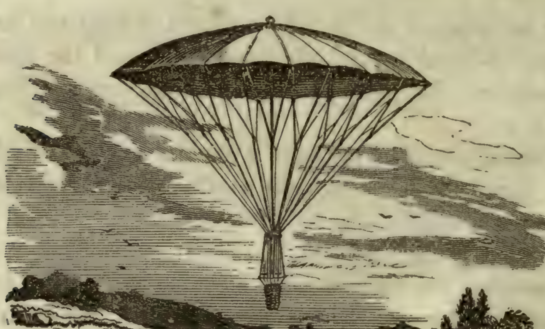
He endeavoured, by means of a circular aperture at the top of the parachute, to correct the vacillations which rendered it so dangerous.

"The parachute," says M. Charles Dupin, "is a sort of circular covering, the circumference of which is fastened down to the basket underneath, by equidistant cords. The centre of it

is immediately under the balloon, and over the aeronaut, who is thereby enabled, in case of alarm, to drop from his balloon to the ground without sustaining injury. This is effected by means of the resistance of the atmosphere. When the parachute is detached from the balloon, and abandoned with its load, in the air, it must proceed at first, from the continued action of gravity, with an accelerated motion until attaining an equilibrium, when it will descend with a nearly uniform velocity."

The parachute is not always a preservative against accidents, as was proved by the unhappy fate of the English aeronaut, Cocking, who left London in a balloon, and at some distance from that city, attempted to descend by means of a parachute of his own invention, and perished in his fall.

Twenty years after the first aerostatic experiments, two men, well known for their scientific reputation, Gay-Lussac, and Biot, made two memorable balloon ascensions, for the purpose of taking observations upon the electrical state of the atmosphere; and at the height of seven thousand yards, found the air to be similar in composition to that on the surface of the earth. After the tragic catastrophe which befell Pilàtre du Rosier and his companion Romain; after the melancholy fate of Arnold and his son, whose aerostat was precipitated into the Thames, a more than common courage was required to brave the dangers of the upper regions.



CHAPTER XXIII.

INSTITUTIONS FOR EDUCATING THE BLIND.

IN placing in the ranks of illustrious artisans the authors of inventions and discoveries useful to the mechanic arts, we have not exceeded the limits of our subject, which are so extended that we have no need of digression. We are sure, however, that our readers will not regret that our popular Pantheon contains an account of the charitable efforts of those who have been the sincere friends of the poor and labouring classes, —the benefactors of humanity. Honour to the glorious inventions of genius! honour also to those of the generous heart!

We speak of the institution for the education of the blind, and of the excellent and modest philanthropist who founded it. Valentine Hauy, brother of the celebrated mineralogist of that name, was much interested in the efforts of the Abbé de l'Epée in favour of the deaf and dumb.

A new idea struck him; would it not be possible to instruct the blind also? Under the influence of this idea, Hauy examined the biography of the blind, and sought out with diligence all facts tending to throw light upon this subject.

"The blind man," said he, "gains a knowledge of different objects by means of the touch, and can distinguish one piece of money from another. Why could he not also distinguish one note in music from another, or one letter in the alphabet from another, if these were rendered palpable? Would it not be advantageous to offer to the blind man's fingers a sign in relief, equivalent to that presented to the eyes of others?"

This theory once admitted, Hauy began immediately to put it

in practice, procuring raised letters and ciphers, and made his first experiment on a young blind man named Lesueur, an orphan, who was in the habit of asking alms at a church door, and whom he had sometimes questioned and found intelligent. To him he explained his project; invited him to come and live at his house, and offered to compensate him for what he would thereby lose of public charity. The proposal was accepted, and the young blind man followed his new protector home.

The zeal of this good man was not long without reward. Lesueur, at the end of six months, could read and cast up figures with his skilful fingers; and had besides learned a little geography and music. Such success excited attention; the public desired to witness so novel a sight. Hauy having occasion to read a memoir upon the writings of the ancients and moderns, and the mode of correspondence by means of ciphers, before an academic assembly, took this opportunity for producing his pupil. The intelligence of the pupil, and the zeal of the master, were loudly applauded. Hauy's method was admired and encouraged. Twelve young blind men were confided to his care, forming a growing institution, which increased rapidly under the auspices of the Philanthropic Society. This was in 1784. Two years afterwards, his number of pupils had doubled itself. The court evinced a desire to behold them at their studies. Their master took them to Versailles, where, for the space of two weeks, they excited great interest. The king took the institution under his protection, making a liberal provision, enabling Hauy to receive as many as one hundred and twenty pupils, and gave this worthy man the title of *secretary-interpreter* to the king, and to the admiralty of France.

The Revolution deprived Hauy of this generous assistance, and the whole expenses of the establishment again devolved upon him. Nevertheless, by dint of great zeal and great sacrifices, he was able to sustain it, although in a very inferior manner.

The Directory restored the protection of government to this

institution and the education of the blind received a new and ardent impulse, which it has never lost.

There is no more interesting sight than that of these young people, whose sense of touch, brought by education to great perfection, compensates, in a great degree, for the loss of sight, and enables them to study many of our arts and sciences. Some occupy themselves with geographical globes, others read or write, decipher music, or perform on some instrument.

Before closing his honourable career, Hauy had the satisfaction of founding similar institutions at Berlin and St. Petersburg. In testimony of his gratitude, the Emperor Alexander decorated him with the cross of Saint Uladimir, and retained him in Russia eleven years; but the desire of revisiting his native soil brought him back to France in 1817, where he died at an advanced age in 1822.

Whoever has visited Clermont, (Oise) has no doubt made a pilgrimage to Liancourt, a small town, agreeably situated on a declivity, at the foot of which spreads a beautiful plain called the golden valley, from the fertility of its soil, and the richness of its verdure.

Before the Revolution, the Chateau Liancourt was finely situated in the midst of this beautiful country, and the gardens attached to it were a beautiful example of the combined attractions of nature and art. Long shady groves, lakes, fountains, and water-falls, contributed to the charms of this beautiful place. The Duke of La Rochefoucauld Liancourt, having directed his attention to the study of agriculture when in England, established a farm at Liancourt upon the English plan, and stocked it with fine Swiss and English cattle. It was through him, that the culture of artificial meadows was introduced into France; a useful means of feeding cattle in winter.

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CHAPTER XXIV.

ROCHEFOUCAULD.

ROCHEFOUCAULD founded a school of arts and sciences for the instruction of the sons of poor soldiers, where he spent much of his time, applauding and encouraging the pupils. This school was, in some sort, the cradle of that at Châlons sur Marne: a practical school, where various mechanical trades were taught, such as carpentry, cabinet-making, and various kinds of work in wood and iron, clock-making, &c.; and which, having for the basis of all instruction the analytic method, drawing and mathematics, has furnished France with many able workmen.

La Rochefoucauld Liancourt also established three important manufactories near his chateau. One of these was for making cards for carding wool, the second was for cotton-spinning, and the third for pottery; employing, in all, three hundred workmen. In the year 1801, the cards introduced by him into France, obtained the bronze medal at the exhibition.

Sent into exile during the reign of terror, La Rochefoucauld Liancourt turned his misfortune to the profit of France. At his return, he introduced vaccination into his own country, and checked the ravages of the small-pox, which was desolating towns and villages. He neglected no means of propagating this wonderful discovery made by Jenner, to whom succeeding generations owe an enormous debt of gratitude.

At home again, this excellent man endeavoured, by various means, to ameliorate the condition of the poor. He taught them the principles of modern agriculture, notwithstanding the brutal opposition which met him at every step. He was one of the principal founders of the Savings Fund, an institution whose

benefits are now experienced by all the labouring classes of France. The venerable name of Rochefoucauld Liancourt was seen at the head of every association for the assistance of the lower classes, were it for educating them, lightening their labour, raising their wages, or impressing upon them the importance of order and economy. At his death in 1827, a number of the workmen of Paris, amongst whom were, no doubt, some old pupils from Liancourt, Compiègne, or Châlons, insisted upon bearing his coffin upon their shoulders. Meeting with a troop of soldiers, a dispute arose, and the coffin was precipitated into the mud. The tumult which ensued was a prelude to the catastrophes of 1830.

Notwithstanding this disgraceful scene at the funeral of the virtuous Duke of Rochefoucauld Liancourt, nothing can ever efface the memory of his public benefits. The introduction of vaccination; the creation of a Savings Fund; the establishment of the Society for Elementary Instruction, and of the School of Arts and Trades (which alone has done so much for the improvement of France, and has been followed by numerous similar institutions), are all so many claims upon the eternal gratitude of mechanics and artisans, to whose service his whole life was devoted.

A like spirit actuated Bachelier, a French painter, of moderate abilities, but especially remarkable for the signal services rendered to the mechanic arts. The institution which does him so much honour, has now been established nearly twenty-four years, and, withstanding all the shocks of our political troubles, still exerts a salutary influence over a great part of the products of Parisian labour. If you have ever had occasion to visit the populous neighbourhood of the School of Medicine, you have, no doubt, observed a crowd of boys hastening onward, each bearing a portfolio of drawings, which, as you may also have observed, serves as a shield in the frequent street combats.

Now and then two walk along together, arm in arm, or leaning on each other's shoulder; and on the newly-plastered wall

opposite, a merry youngster traces a grotesque profile. By the simple dress, the animated face, the little cap placed negligently on the side of the head, and the general appearance of good will and mischief, you may easily recognise the children of the lower classes.

These are the sons of mechanics, destined for mechanics themselves, who go to the Bachelier school to study drawing.

It was for this class that Bachelier founded his free drawing-school, in 1763, spending upon it 60,000 livres, economized from his own private fortune. He hired the old college of Autun, in the Rue Saint André des Arcs, and in 1766 opened with fifteen hundred pupils. One year afterwards, when its success was certain, the king gave him 1,000 louis, and granted him letters patent. Princes, courtiers, men of the world, all classes imitated the example of the monarch; and voluntary subscriptions, joined to a slight tribute from masters and apprentices, formed a revenue of 45,000 livres, which provided more than fifteen hundred pupils with the necessary instruction.

"If we consider," says a biographer, "the influence exerted by it for more than half a century upon the mechanic arts, this school, established by Bachelier, has done great things for France."

The manufactory of Sevres owes its first progress to Bachelier, who directed it for forty-four years, introducing many reforms in art and taste. He not only assisted Caylus to reproduce the encaustic painting of the ancients, but also discovered another species of encaustic, used by the Greeks, to preserve marble statues from the injuries of the weather.

M. de Caumont.

CHAPTER XXV.

BOOKBINDING—LITHOGRAPHY.

SOME pages not without honour to the mechanic arts, are furnished by the annals of French emigration. Among the noble families who were obliged to leave their country, many could be mentioned, who, stripped of all their property, were obliged to have recourse to manual labour; thus verifying the almost prophetic justness of Rousseau's solemn warnings, a man who was often looked upon as a visionary, because he advocated the useful instruction of the children of the rich.

"You trust," said he, "to the present state of society, without reflecting that this order is subject to inevitable revolutions, and that it is impossible for you to foresee the fate of your children. The great will become insignificant, the rich will become poor, the monarch a subject; the blows of fortune are not so rare, that you may hope to be exempt from them. *We are approaching a crisis, and an age of revolutions.* Who can answer

for the future? All that men have done may be overturned; nature alone is eternal, and nature never made a prince, a rich man, or a great lord."

When the critical moment arrived, this mournful truth was fully proved. Gentlemen, accustomed from their infancy to a luxurious and elegant life, and to all the pleasures of refined society, were suddenly reduced to the exercise of the most humble professions. Many emigrants taught music and drawing; others gave lessons in the French language, and in literature; whilst the mechanic arts furnished numbers with bread.

M. and Madame Latour du Pin, who had spent their lives at the French court amid a round of gaiety and splendour, removed to America, and took a farm on the banks of the Delaware. M. Latour du Pin performed by turns the duties of a field labourer, wood-cutter, architect, and mason; and his wife, metamorphosed into an intelligent and active housekeeper, baked bread, performed all the household duties, and carried to market various garden vegetables, and poultry raised by her own hands.

M. de Caumont, adjutant-general, and belonging to one of the best French families, went to London and studied bookbinding.

Laying aside his sword and gilded shoulder-belt, he put on a workman's apron; and, animated by a noble ambition, he determined to improve his new art.

M. de Caumont had often admired the rich bindings handed down to us from past centuries; prayer books with their brilliant covers ornamented with topazes and rubies; missals adorned with miniatures of the Byzantine art, sparkling with emeralds, with clasps of ivory, gold, or silver, with an amethyst in the centre set in silver, according to the custom of Saint Eloy, gold and silversmith to King Dagobert.

Caumont's object was not to attain a like richness in the art of bookbinding, but to give it a more than usual elegance. In this he succeeded; his bindings were solid and at the same time light, and possessed a grace and elasticity which rendered them very valuable. In a few years, he became one of the most skil-

ful bookbinders of his time; and English ladies of rank crowded to the workshop of the former French nobleman, who had lost none of his dignity in losing his rank.

Let us return to the subject of inventions. The period which occupies us, that is to say, from the beginning of the Revolution to the first year of the imperial government, was very fertile in this respect.

Lithography, that ingenious discovery which has given a rival to engraving, dates from that epoch. At the beginning of this century, says the *Encyclopedia*, an ingenious man proposed a method of drawing or writing upon stone, so as to obtain several hundred fac similes of the original upon paper. This fortunate discovery, of a nature to create a revolution in the arts, was not well received in the beginning; the composition of the pencil or ink used in it, being kept secret, created a suspicion of quackery. Nevertheless, lithography advanced rapidly, and soon overcame all obstacles.

The glory of this invention is due to a poor chorister in the theatre at Munich, named Aloys Sennefelder. He first observed the property possessed by calcareous stones, of retaining a drawing made with oleaginous ink, and of transmitting it faithfully to paper when strong pressure was applied. He also remarked that the effect could be repeated by moistening the stone, and renewing the ink in every line of the drawing.

In 1788, Sennefelder obtained from the King of Bavaria an exclusive privilege for the exercise of his process for thirteen years, and founded a lithographic establishment at Munich.

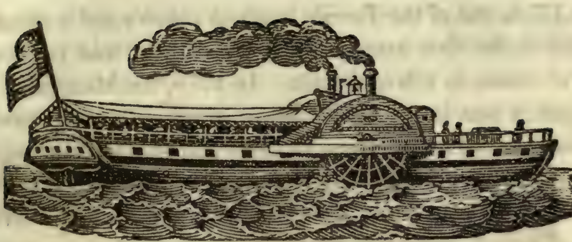
Sennefelder made this discovery in Germany, in 1783. A short time after, it was introduced into France and England, by Mr. Andrew Frankfort; but it met with no success in France, whilst in England it was carried on to great advantage.

It was not until towards 1815, that lithography was practised in Paris. Since then, every year has beheld new improvements in that art, so useful to arts and sciences. By its means, copies of writings are produced with an exact imitation of the hand-

writing, where manuscripts would be inconvenient. Faithful copies of our best masters are also executed at a very small price. Manufactories have made use of lithography for ornamenting pottery, china, and porcelain; for printing goods of all kinds, leather, wood, varnished metals, &c.

France owes these great advantages to the Count of Lasteyrie, an enlightened philanthropist, who made several journeys to Munich for purposes of observation, and formed an establishment which gave the first impulse to French lithography.

When our subject shall have reached the present epoch, we shall have new improvements, and labour-saving methods to mention. Let us now merely state, that if lithography does not possess the purity and vigour of engraving, or were it even without any of the numerous advantages which cannot be denied to it, it has at least that of reproducing with great facility, pictures, the execution of which, if not elegant, is at least striking; and embraces a number of details belonging to the dominion of the arts and sciences.



CHAPTER XXVI.

STEAM POWER—MANUFACTURE OF SUGAR.

STEAM had long been considered capable of the most astonishing effects. Our readers will recollect what we have already said concerning the researches and the labours of Solomon de Caus, Papin, and Newcomen. It was reserved for science to conquer and direct this mysterious power, rendering it useful for navigation, and consequently beneficial to science.

Several trials had been attempted, before steam navigation was undertaken on a large scale.

The illustrious Arago considers Papin as having proposed the application of steam to navigation forty-two years before Jonathan Hull, to whom the English ascribe the discovery.

The proofs cited by M. Arago in support of his opinion are incontestable. Papin's process of changing the rectilinear movement of the piston into one of continued rotation, is not inferior to that of the English mechanician. As to the substitution of wheels furnished with paddle-boards, for common oars, it is due to an engineer named Du Quet, in 1699. Nevertheless, Jonathan Hull deserves particular mention for having applied steam to these wheels as a motive power.

In 1775, one of the Perrier brothers constructed a steamboat. This was the first attempt of the kind, but was followed by several others on a larger scale. In 1778, the Marquis of Jouffroy put a boat in motion by means of steam, and repeated his experiments with a boat one hundred and thirty-eight feet long, and fifteen wide; but being obliged to emigrate during the revolutionary troubles, steam and steamboats sank into obscurity.

In England, experiments of the same kind were made by Miller, in 1791; by Lord Stanhope, in 1795; and by Symington, in 1808, who propelled a steamboat in a canal in Scotland.

It remained for the celebrated Fulton, of whom we have already spoken, when on the subject of panoramas, to put in motion the first steamboat which appeared on the Seine. This was in 1803; a few years afterwards, he built a steamboat on the same plan at New York, for transporting men and merchandise from that city to Albany. These first attempts were far from presenting the elegant appearance of the modern steamboat.

Notwithstanding the numerous improvements in the construction of steamboats, and the invention of the safety-valve by Papin, so useful for preventing explosions, it still remains to be desired that theory should furnish some means of imposing restraints upon the ungovernable elastic power of steam; the terrible effects of which are well known in all countries.

Chemistry, a science of which we have already related so many marvels, has taught us to extract sugar from the beet, a plant formerly deemed utterly insignificant. Oliver de Serres, one of the most learned agriculturists of France, was the first who mentioned this plant, which had been brought from Italy in 1599.

Margraff, a Prussian chemist, being acquainted with the nature of the beet, endeavoured to extract sugar from it in 1747. But he reaped no advantage from this important discovery, nor was it until half a century afterwards, that Charles Frederic Achard repeated these experiments, making use of the same plant (*beta cycla alba*), whose principal characteristic is its

extreme whiteness. If the glory of the invention did not belong to him, that, at least, of putting principles into practice does; for he, in 1800, began to extract sugar from this plant.

In the month of July, 1808, the Institute of France pronounced an honourable eulogium upon this Prussian invention, declaring it to be likely to become a source of national profit.

To enable Achard to carry on his experiments on a larger scale, the King of Prussia gave him an estate at Runern, in Breslau, in Silesia, where this chemist established a factory, which attained so great a degree of improvement at the time of the continental blockade, as to furnish three hundred pounds of sugar daily. He afterwards attached a school to the establishment, for the study of this novel subject, which was frequented by a great number of strangers. Achard's methods are to be met with in several works which he has published upon the extraction of sugar from beets.

The sugar thus made now rivals that from sugar-cane; but great care and minute research have been required, as well as the careful culture of the beet.

M. C. Tollard the elder, (Article *Beet*, in the *Dictionary of Conversation*) claims the honour of this agricultural innovation—

"Before the extraction of sugar from beets was practised in France, and before the government had commanded it to replace that of the colonies, I had, in my *Treatise upon Vegetables*, mentioned the existence of saccharine in the plant, and spoken of the factories established in Prussia, by Achard, Director of the class of physics in the Academy of Sciences at Berlin; and on this occasion, that philosopher wrote to me on the 4th of April, 1804, from Runern, near Steinau, in Silesia, where was his plantation and his factory. I was, therefore, the first in France to point out and propose the extensive cultivation of the beet. I have devoted much attention to this subject."

Go into one of our numerous sugar-houses: observe the fine quality of the products, &c., &c. There is no need to speak

of the rapid increase of this new article of trade, upon which, according to some, a limit should be placed, or the great amount produced will, before long, by causing excessive competition, become rather an evil than otherwise, to those employed in the sale of it.

It is not our design to offer our readers dry statistics, in which the precise order of dates should be scrupulously observed; nor has it been our plan to present a collection of minute biographical notices, beginning at the birth of a celebrated man, and terminating at his death. In either of these cases, it would have been indispensable to adopt a different system from that which we have followed. Wishing merely to pass in review the scenes of the work-shop, especially those which, through useful inventions, or other memorable benefits, have sacred claims upon the gratitude and veneration of the labouring classes, it has appeared to us more appropriate and more interesting to group all these diverse remarkable portraits in cotemporaneous frames, without hesitating to cast an occasional glance into the past or the future, for the sake of recurring to the origin of a discovery, or of following the course of its progress. Such is the object we have desired to attain, such the plan we have heretofore followed, and to which we shall faithfully adhere throughout our subject.

CHAPTER XXVII.

ARCHITECTURE OF DWELLING-HOUSES—FORTIFICATIONS.

TOWARDS the end of the eighteenth century, and the beginning of the nineteenth, the existence of the French republic was more nominal than real. One great man, already immortalized by glorious victories, was preparing a monarchy with his powerful hand. The public mind, fatigued with the irregularities of anarchy, felt the want of internal peace, of order, and of prosperity, to commerce and the arts. Manufactories opened on all sides; the song of the workman mingled with the grating of the file, and with the heavy blows of the hammer on the sonorous anvil.

"The choice of materials," says M. Charles Dupin, "and the care and attention employed upon them, marks the opulent possessor. The levelling spirit of the age betrayed itself in the

new mode of building houses, with an increased regard to convenience and health."

The middle classes improved in taste, that gratuitous wealth of a civilized people which can embellish the humblest dwelling; without any additional expense, it brings doors and windows to a uniform height, whereas, in former buildings, these were never similar, symmetrical, regular, or rectilinear. The low price at which glass could be obtained caused the old-fashioned small panes to be replaced by large ones; the staircase was placed inside; the opaque shutter gave way to the light and agreeable Venetian blind; the ground floor, formerly so damp and unhealthy, was raised, and rendered dry and comfortable. . . The peasant felt the advantages of this system; and, by degrees, became accustomed to the use of glass in his window instead of oiled paper. The ancient tiled floors gave way to a brick pavement; the stool to a chair, &c., &c.

These improvements were introduced by degrees, although with some rapidity. Interior arrangements progressed in the same manner. Locksmiths, joiners, and other household artisans, gained a new impulse. Metals were drawn out, and iron plates rolled into cylinders, and mouldings of various kinds. A taste for stucco work, castings, columns, cornices, capitals, and various similar luxuries, spread through all classes.

At the same time the great labours, begun under the old monarchy, were again undertaken, and carried on with new vigour.

Louis XVI. entertained the idea of making Cherbourg important as a fortified town, as well as a commercial one, and a military port; and had put some of his plans into practice, when he was interrupted by the Revolution. The proximity of Cape Hogue, in recalling the memory of the ancient Coricillum, gave a deep interest to these labours. It was thought necessary to give this town two entirely separate ports: one for commercial, the other for military purposes. A breakwater was also needed to protect the anchorage of the bay. The construction of this breakwater presented so many difficulties, that its execution was

looked upon as something gigantic. The depth of the water in the southern seas added to the obstacles which impeded the plan; but the man of genius and determination, who said, and proved by frequent actions, that there was no such word as impossible, resolved to realize this vast project. This was at the beginning of 1803. The hero of Italy and Egypt was then only first consul of the republic. Adopting the plan of Cachin, the engineer, he directed that the port should be constructed fifty feet below high tide, for the reception of the largest men-of-war. Wooden cones, sixty-nine feet high, with a diameter of one hundred and forty feet at the base, and sixty at the summit, were erected. These were filled with stones, and sunk; the intervals were also filled with stones, thrown in at random. Overturned at first by the waves, the mass of accumulated stones offers a powerful resistance to the violence of tempests, and is of great use in the preservation of vessels anchored in the bay. This mass is composed of 500,000 cubic fathoms of waste stones, and of enormous blocks of freestone and granite, brought from the Roule Mountain. The object of this breakwater is to diminish the fury of the winds and waves, so as to procure a calm in the interior, and to protect the parts of the bay which are beyond the reach of the artillery of the fort.

It would take too long to enumerate all the improvements since made at Cherbourg; they are on a very large scale, and there remains yet more to be done. The bay now offers an excellent anchorage; it is defended by three forts: the Royal Fort, the Fort d'Artois, and that of Querqueville. The commercial port is very convenient, and forms an excellent place of refuge to all the coasting-vessels in this latitude.

The military port is defended by a tower-like enceinte, with a moat partly dry. Hollowed out in the Galet rock, it presents an outer harbour, which, even during low tide, has twenty-five feet of water. Ships, which are continually arriving here, remain a short time in safety, and are afloat in all states of the

tide. It is surrounded by magazines and buildings connected with the service, and can contain thirty vessels of the line.

Let us return to those scientific men who have done so much for the arts, and for humanity itself.

Guyton De Morveau, by the discovery of the peculiar properties of chlorine, succeeded in overcoming the ill effects caused by the exhalations from decayed animal or vegetable matter. His object was to prevent infection in hospitals and prisons; but the plan has been extended to dwellings and workshops, and also manufactories, where any deleterious substances are used.

Bertholler.

CHAPTER XXVIII.

IMPROVEMENTS MADE IN DYEING BY BERTHOLLET—HIS HEROISM—VACCINATION IN FRANCE—AGRICULTURE.

BERTHOLLET, another chemist, a disciple and rival of Lavoisier, distinguished himself in the annals of mechanic arts, by indicating the use of chlorine, then called oxymuriatic acid, for dyeing.

"Cloth," says M. Gaultier de Claubry, "upon leaving the hands of the weaver, bears a faint colour, which must be made to disappear entirely, before the material can be dyed. This was formerly effected by bleaching on the grass, and repeated washings, a long and inconvenient process, and one requiring great extent

of ground. Berthollet substituted the chemical process, now in general use, and which has also been applied to the preparation of paper, which is now brought to a degree of perfection, never attained under the old methods.

Berthollet united great energy of character to remarkable scientific capacity. M. Pariset, in his eulogium on this great chemist, relates an anecdote which deserves to be made public. During the bloody period of the revolution, when the self-constituted tyrants of France exacted an implicit obedience, under penalty of death, Berthollet was commanded to examine some brandy, suspected of being poisoned. Meeting with no injurious substance in it, he sent in a favourable report, which, however, did not satisfy them, as their object was to get rid of him, and take possession of his property. He was sent for and interrogated.

"Are you sure of what you tell us?" asked those in authority, in ferocious accents.

"Perfectly sure," replied Berthollet, with calmness.

"Would you be willing to make the experiment on yourself?"

Berthollet filled a glass and drank it off.

"You are very bold," remarked one.

"Less so now than when I wrote my report," replied the courageous chemist.

Towards the close of the eighteenth century, science taught men to overcome that fearful scourge, the small-pox, which annually carried off one-tenth of the inhabitants of the fields and villages, attacking with redoubled fury the poorer classes, who were deprived of the comforts of life.

In several parts of England, distinguished for their excellent pasturage, especially in Gloucester, the cattle are subject to an eruption on the udder. It was observed that this eruption was communicated to the hands of the milkmaids, and that, having caught it, these people were afterwards exempt from the contagion of the small-pox, from which numbers around them were suffering.

Dr. Jenner turned his attention to this subject, and submitted it to various experiments, for the purpose of ascertaining the precise nature of the facts. He remarked, that many individuals, who had more or less lately caught the vaccine from cows, did not take the small-pox upon being inoculated; the slight nature of the disease thus communicated, induced him to vaccinate several people, who also experienced no effects at all from subsequent inoculation.

These experiments, according to the authors of the *Dictionnaire des Origines*, were repeated in London, where numbers, of different ages, were vaccinated with great success.

The renown of this interesting discovery soon travelled to Paris, where new experiments were made, and the vaccine propagated. In three or four years, from 1798 to 1802, it made the tour of Europe, and penetrated into Asia.

The glory of this discovery is not entirely owing to England. Rabaud Pommier, a brother of Rabaud Saint Etienne, a Protestant minister, had an idea of this valuable improvement before Jenner, who, however, by his experiments first established the efficacy of the vaccine, and put it in practice. A public benefit, whose importation and propagation in France are due, as we have once before said, to the enlightened zeal, the virtuous philanthropy of La Rochefoucauld Liancourt! A benefit also providential, in that it saves whole generations from a dreadful death, or a hideous living deformity, and materially aids the progress of agricultural improvement by retaining in its service thousands of vigorous labourers.

If we turn our attention to the subject of agriculture, the art which provides the working class with food, we must not forget to do homage to the memory of Brémontier, a naturalist and philosopher. It was he who first planted downs, or dunes, and invented an ingenious process for arresting the course of the moving mountains of sand, which threatened to invade, by degrees, all the cultivated land, and to render it sterile. He also

taught the art of fertilizing sandy soils, and making them productive.

A short time after the death of the unhappy Louis XVI., French agriculture, and French commerce also, began to profit by the merino sheep, brought from Spain, whose fleece is so fine and thick.

The Spanish government forbade the exportation of this breed of sheep, and it was merely as objects of curiosity that Louis XVI. was able to obtain a few individuals of the race, which were placed in the royal park at Rambouillet. "Thence," says M. Charles Dupin, "sprang the line of sheep from which France has derived so much benefit. Proposals were made to farmers to undertake the care of these animals, but, strange to say, were refused, until a price was put upon them, when they were readily disposed of."

Daubenton, the illustrious rival of Buffon, deserves eternal gratitude on the part of France, for his efforts in this branch of industry. We will give the words of the above-mentioned learned man:—

"From 1766 until 1808, Daubenton abandoned, in some degree, his former researches in comparative anatomy, and began the study of the Spanish sheep, their diet, and the treatment of them in various respects. He discovered a method of refining the fleece, by a system of careful and continued attention, applied to the unmixed race, and invented a micrometer for measuring the most delicate wool. He established a sheep-fold on an extended scale, which became a school of shepherds, having at its head a man of genius, a talented professor. He presented his products to the most skilful weaver, as a proof that Spanish wool is in no wise deteriorated by being produced on a French soil; and he, Daubenton, was obliged to wait seventeen years before the manufacturers would give him one trial (in 1783);—before the valuable facts brought to light by him were of sufficient strength to overcome the force of prejudice. This learned man went farther still; he affirmed that, through his method, the

wool grown in France possessed more beauty and more equality of length than that of Spain.

"The indefatigable Daubenton did not suspend his studies until he had composed a set of agricultural instructions for the people, pointing out all the advantages to be gained by the continuation of the mongrel, as well as the pure breed, either with respect to present or future profit. He did much towards the enlightenment of the shepherds, upon whose care and judgment the welfare and prosperity of the flocks so much depend.

"Under the National Convention, when Daubenton required an immunity from persecution, he obtained it in the humble capacity of a shepherd. Seven years afterwards, when the first consul was forming a conservative senate, to be composed only of men who had been eminently useful to their country, he sought Daubenton at his sheep-fold, and placed him side by side with generals, judges, and the most learned men of the age."

Before concluding our work, we shall more than once have occasion to recur to Daubenton, and the wonderful progress of that branch of art, which, it may be said, originated with him.

CHAPTER XXIX.

LEPAUTE—CLOCK AND WATCH-MAKING—JULIEN LEROY—PIERRE LEROY.

IN the year 1802, died the celebrated watchmaker, Jean Baptiste Lepaute. Let us speak a few words on the subject of this family of illustrious mechanics.

Jean André Lepaute, the elder brother of the one just mentioned, was born at Montmedy, in 1709. He repaired to Paris at an early age, where he entered into friendship with the geometrician Clairaut, and Lalande, the astronomer. He executed, in 1753, for the Luxembourg palace, the first horizontal clock ever seen. He invented an escapement which is esteemed one of the best. He presented Louis XV., in 1751, with a watch which had but one wheel.

In his treatise on horology, he gives a description of a clock which never required winding up; but this was not a perpetual motion in the strict acceptation of the word.

A clock of his is also mentioned, which he called *polycameratic,* because it struck the hour in the different rooms of a house. Jean André Lepaute was of great service to his art; he was one of the small number of artists who know how to unite to theory the practice of the physical and mathematical sciences.

As to Jean Baptiste Lepaute, he was his brother's most assiduous companion and assistant. His most admired production is the fine clock in the *Hotel de Ville* at Paris, which is considered a masterpiece of art.

Another artist, and a competitor of Bréguet, deserves a distinguished place in our gallery. Ferdinand Berthoud has bequeathed his talents to his descendants. A Swiss by birth, and destined by his family to the pulpit, his natural tastes showed a strong inclination to clock-making, and induced him to come to Paris to study this art, as well as mechanism in general.

Ferdinand Berthoud is the first who firmly established the theory according to which machines for the measurement of time in common use are constructed. His essay upon watch-making, and his treatise upon marine timepieces, are highly valuable to the French nation.

His marine timepieces were examined by Borda and other men of science, who proved that they showed the true longitude at sea within a quarter of a degree, or five points at the utmost, after a six weeks' voyage. It may also be remarked, that their regularity was in nowise affected by the firing of cannon. Ferdinand Berthoud, like Bréguet, a member of the Institute, contributed as well as he to the progress of science, both by discoveries and experiments. This illustrious clockmaker educated a pupil worthy of himself: this was Louis Berthoud, who gained a prize at the Institute in 1799, for a chronometer for the decimal division of time.

He constructed chronometers whose beauty and accuracy were appreciated by all men of learning; and he obtained, besides the title of marine watchmaker, the privilege of taking pupils, whom he instructed in his art. In after years, his sons proved by the success attendant upon their efforts, as seen at the annual exhibitions, that the family had in nowise degenerated.

Nothing contributes so much to the glory of the arts as hereditary talent in families. Of this, we have already cited several examples. The end of the last century presents one, which we must not pass over in silence.

Let us go back to the year 1686. In that year was born Julien Leroy, at Tours, who from his earliest infancy betrayed a decided talent for mechanism. At the age of thirteen, he

constructed several little clocks. Some years afterwards, he went to Paris to perfect himself in the theory and practice of his art, and soon rose to distinction, his watches rivalling those of the English, heretofore sole masters of the science.

Graham, the most celebrated English watchmaker, upon seeing a watch made by Leroy, paid the following honourable tribute to the young man's talents: "I sincerely wish," said he, "that I were younger, so that I might make a watch in imitation of this."

Voltaire said one day to one of Leroy's sons, "Your father and Marshal Saxe have conquered the English."

We must add to Leroy's praises, that he was benevolent; that he sought out the indications of talent in his workmen, assisting them with money; and when satisfied with their labours, it was his custom to pay very high wages.

After his death, his son, Pierre Leroy, profiting by his father's instructions and example, was crowned by the Academy for his marine timepieces, which were as remarkable for precision as simplicity.

CHAPTER XXX.

LAMPS—ARTIFICIAL LIMBS, ETC.

LAMPS, from the time of Argand down to the present day, have undergone great improvements.

First on our list, stands Lebon's thermo-lamp, invented in 1799, and which, two years afterwards, gained him a gold medal. Lebon discovered a method of in some degree condensing the flame produced by ordinary combustion, and thereby giving it a brilliancy sufficient for a large apartment, an entry, or a staircase.

As M. Charles Dupin observes, Lebon made use in his lamps of the carburetted hydrogen, since employed for lighting streets.

After the thermo-lamp, comes the *docimastic* lamp, or fountain of fire, excellent for soldering metals, glass-blowing, and various mineralogical experiments. The inventor was Bortin.

Previously, in oil lamps, the reservoir was placed above the burner, thereby causing an inconvenient shadow. It was very desirable to find a means of obviating this difficulty, as well as of preventing the continually recurring necessity of bringing the oil to a level with the flame.

Carcel, whose name, like that of Quinquet, enjoys a universal celebrity, was the first who, towards 1800, constructed a lamp which shed a strong light on all sides without any shadow

whatsoever. This was effected by means of internal mechanism.

In the Carcel lamp, the reservoir is at the foot, and the oil is raised to the wick by means of a small pump. A wheel-work acted upon by a spring, says the *Dictionary of Conversations*, and which is wound up like a watch, sets in motion two pumps, which continually raise the oil to the burner. This wheel-work will act eight or ten hours without winding up.

There is reason to believe, that if the inventor had lived longer, he would have successively applied the various improvements of which this lamp is capable. It is also probable that he would have reduced its price; for the present Carcel lamp is very expensive. The light of this lamp is very injurious to the eye, from its extreme brilliancy; and a shade of ground glass, or gauze, is generally used, and lately one of porcelain, of a cylindrical or prismatic form, ornamented with figures in relief, presenting very much the appearance of a fine English engraving.

The Girard brothers were rivals of Carcel, and arrived at the same result as he, by an ingenious application of the hydrostatic fountain.

Whilst these numerous inventions enriched the dominion of industry, the French armies, defending the territories of their republic with heroic energy, opposed victory after victory to the incessant attacks of a formidable coalition. Nevertheless, these regiments of brave soldiers, who went so gayly forward to meet death, were in absolute want of the necessaries of life. A patriotic enthusiasm sustained them under numerous privations. The Marseilles Hymn inspired them with a generous ardour. Glory was sufficient indemnification for all sacrifices. To repulse the enemy was the all-absorbing idea. The youth, become a soldier often against his will, rivalled those who enlisted voluntarily; and, developing his energies on the field of battle, rose rapidly to the rank of general, and learned to command with great skill, uniting the fearless intrepidity of youth to the

reflective courage of age. How many heroes might have said, like the one of Corneille,

> "Je suis jeune, il est vrai, mais aux âmes bien nées,
> La valeur n'attend pas le nombre des années."

Nevertheless, these poor fellows were often without bread to eat, and had only rags to wear; but no head hung down timidly, no hand held a musket less firmly, no heart flinched before the enemy. The bivouacs sometimes offered a curious spectacle. Here and there might be seen a soldier taking advantage of a few leisure moments to mend his shoes, which had already lost all appearance of upper-leather, whilst the sentinels dragged heavily after them immense wooden sabots.

The government was anxious to provide for these urgent wants, but this was a matter of some difficulty. To supply all the numerous French armies with shoes, would have required an outlay entirely disproportioned to the funds, and the mere tanning of all the necessary leather would require a whole year.

Armand Seguin, by a close attention to the subject, discovered a mode of preparing leather, by which he reduced to the space of a month this hitherto long and tedious process; and, although still far from perfection, his plan was adopted, to the great benefit of the French army.

The mutilated condition of many of our veterans now began to attract public attention, and wooden arms and legs were constructed to supply those sacrificed to the enemy's fire, or the surgeon's steel. These, although without the glory of being an invention, are to be ranked high as a useful improvement.

The mechanician Laurent or Laurens, son of a sluice-keeper of Bouchain, became justly celebrated, by the skilful application of his art, and the more so, as he was almost entirely without education. He drained marshes in Flanders and Hainault, which had been abandoned as impracticable; facilitated the navigation of the Scarpe, and constructed sluices in other rivers, where they were much needed. The junction of the Escaut and the Somme presented insurmountable difficulties; but Laurens

determined to master them. He effected this by a subterranean canal, three leagues in length, which united with the Escaut, forty-five feet above its source, and with the Somme, fifteen feet below its bed.

The beautiful falls of water at Brunoy and Chauteloup, are also the works of Laurens.

We must not omit to mention an artificial arm, constructed by Laurens for an invalid soldier, by the aid of which he wrote a petition in the presence of the king, and presented it to him, although but four or five inches of one arm remained to the man, and nothing at all of the other.

Long before this mechanician, there had been fortunate experiments made in this branch of art. Ambroise Paré, the celebrated surgeon of the sixteenth century, speaks, in one of his works, of hands, arms, &c., of forged iron. We read also, in Fontenelle's Eulogium on P. Sebastian Truchet, that Gunterfield, a Swedish gentleman, came to Paris, to provide himself with two hands, having lost his original ones in battle, and having but two short stumps left. He desired to have arms made, which should, in being fastened to these stumps, move with them, and terminate in flexible fingers. The English, little accustomed to acknowledge the superiority of France, sent him to Sebastian Truchet, who had already exhibited several of his works to the Academy. But being called upon to execute the Orleans canal, he abandoned his former occupations, probably without much regret, to a mechanician with whose talents he was well acquainted, and whom he judged able to follow, or to improve upon, his own views. This was Duquet, whose inventions were approved of by the Academy, and who made an arm which would raise itself to the head, take off the hat, and put it on again. But Gunterfield, wearied with the delay required for all this, and become, by long habit, accustomed to the privation, left Paris and returned home.

At the time of the wars of the republic, this useful invention was again taken up, and received considerable improvements.

In 1798, Thevenin obtained a medal from the Lyceum of Arts, for the invention of an artificial hand, which imitated the movements of the natural hand. The ends of the fingers were furnished with little moveable pieces, which, being lightly pressed, set in motion springs, indicating to the stump the degree of pressure requisite for the object held in the fingers.

In 1801, Bernard, a writing-master in Paris, invented a supplementary artificial arm; by means of which, a man without arms could write and mend his pens with ease.

An invalid, who had left both arms on the field of battle, made a trial of this artificial arm in the presence of a numerous assembly, and wrote and mended pens with such success as to strike all the beholders with admiration.

Knowledge on all scientific subjects now advanced rapidly. The progress of mineralogy, physics, and chemistry, involved that of the ceramic arts, that is to say, those which produced bricks, tiles, and various kinds of pottery, for domestic uses. Towards the end of the last century, Fourmy, a skilful potter, endeavoured to bring this branch of art to great perfection, by rendering earthenware less porous, and obtaining any earthy varnish as fusible as if it contained lead. In all this he succeeded admirably; but made the common mistake of raising his prices, and thereby prevented his improvements from becoming popular.

At the exhibition of 1802, a large work in terra cotta was exhibited. It was the lantern of Demosthenes, a Corinthian rotunda, remarkable for its lightness and elegance. It was afterwards placed in the park at Saint Cloud.

Weaving next claims our attention. The flying shuttle, the instrument used by weavers to guide the thread it contains, so as to form the woofs of stuffs, cloth, linen, and other fabrics, had been invented for more than half a century; but its use was little known. Weavers had been in the habit of throwing the shuttle across the stuff, which, when it exceeded three feet in width, required two men at each machine; one throwing from right to left, the

other from left to right. John Ray invented a simple and ingenious improvement: this was the flying shuttle, by means of which one man could weave stuffs of all widths, twice as fast as formerly and without any assistance. The flying shuttle was first used in woollen factories, but was not employed in the fabrication of cotton for some years, that branch of industry being considered too unimportant to attract public attention.

Under Necker's administration, Delasalle, a manufacturer of Lyons, invented new improvements, which he obtained permission to place in the Chateau of the Tuileries. He exhibited flying shuttles very superior to those in common use, and destined for making gauzes, and other wide stuffs. Delasalle was rewarded by a pension, and an admittance into the order of Saint Michael. Nevertheless, he is not the inventor of the flying shuttle, but the Englishman, John Ray, who first brought it into use in 1738. National vanity should never exceed the bounds of truth. Delasalle could not invent what existed before he himself. But we will do him the justice to admit that he was the originator of many useful improvements.

In 1801, appeared the Bauwen brothers, from Passy, with a new flying shuttle, which attracted general attention. The French government favoured the establishment of these industrious men, by furnishing them with workmen from all other manufactories.

Two names, rendered celebrated by heretofore-mentioned discoveries, are associated together, and renowned by the invention of a new hydraulic or water ram. Mongolfier made the first application of his machine at his paper-making establishment in Vorron, in Dauphiny.

The only condition indispensable to the employment of the hydraulic ram, was a sufficient fall of water; for, as has been remarked, the momentum of a stream of water flowing through a long pipe, will raise a small quantity of water to a considerable height; and consequently, is able to set any machinery in motion. In a word, the hydraulic ram unites the advantages of

turning water to a useful purpose, to procuring a constant and abundant supply, and is besides the least expensive mechanism in this line.

The water arriving at the reservoir with the velocity due to the height of the fall, is received in a pipe which has a slight inclination during its whole length. This pipe, closed at the lower extremity, is called the body of the ram; the horizontal portion is the head of the ram; upon this head are made two orifices, upon which two valves fit exactly, and which open and shut in opposite directions from each other. There is an ascensional tube rising from the reservoir. The valves are formed of hollow balls supported on muzzles, and are of such a thickness that they weigh about twice as much as the quantity of water they displace. The water flowing through one orifice, acquires the velocity due to the height of the fall, and raises one ball from its support till it comes to the other orifice. The extremity of this orifice is covered with leather, or with cloth filled with pitch, so that when the ball is applied to it, the passage of the water is effectually prevented. As soon as this orifice is closed, the water raises the second ball or valve, and introduces itself into the ascensional tube. Meanwhile it gradually loses its rapidity and force, and the balls fall down in consequence, the one on its support, the other on its orifice. When this takes place, every thing is in the same state in which it was at first. The water begins again to flow through the orifice; one valve is shut, the other open; and the same effects are repeated in an interval of time which, for the same ram, undergoes little variation.

As the ascending column of water communicates with the air in the reservoir above, this would soon be exhausted if a fresh portion of air were not introduced at each stroke of the ram. The little tube which is stopped by a valve opening inwards, serves for this purpose. At the instant when the first orifice closes, a recoil takes place, by which the water is thrown back

from the head of the ram towards the cistern, and a partial vacuum being thus produced within the cylinder, the pressure of the external atmosphere forces open the valve in the ascensional pipe, and a portion of air enters the cylinder, whence it is driven into the reservoir. In this manner the water is raised without interruption, both by means of the power of the ram and the elasticity of the air.

CHAPTER XXXI.

PAPER AND PRINTING.

UNTIL 1799, paper had been made upon the old plan; but man's labour was a slow and ineffectual means, compared with that of machinery.

About this time, Louis Robert, a mechanician of the pretty town of Essone, near Corbeil, invented a machine for making paper on a vast scale.

The following is a summary description of this machine:—"The stuff having been prepared and bleached," says M. Gaultier de Claubry, "falls through a pipe into a large wooden tub, where it is kept in continual motion by means of revolving fans, and thence passes through an opening, down upon an endless web of fine wire, which is kept continually moving in a horizontal direction over a series of revolving rollers; the water partially sinks through the fine apertures of the webbing, and the pulp alone is retained. From this it travels to a web of cloth or felt, and after being pressed between rollers covered with either of these materials, is dried upon cylinders, and, lastly, unrolled upon drums, which, when full, are replaced by others. The various processes are highly interesting to the beholder; from the trituration of the rags, and their separation from the water, to the formation of wide sheets, of indefinite length, which are fit for use as soon as dried, a process rapidly effected by means of heat applied to the cylinders.

"This mode of making paper is one of great utility; for by it immense quantities are produced in sheets of all sizes, which are brought to perfection in one single operation."

We have already mentioned the early efforts in favour of printing, made by Guttemburg, Laurentius Coster, Faust, and Schœffer. Since the fifteenth century, this art, which does so much honour to the genius and patience of the inventors, has made rapid progress, and received much assistance from the labours of several families of rank. A short account of them will not be out of place.

Aldus Manutius was the chief of the family of printers of that name, which acquired so much renown whilst the art was new. No one contributed more than this learned man to the perfection of the art of printing.

By his indefatigable perseverance in deciphering manuscripts, his patience in comparing texts, and supplying the omissions of copyists, and the enlightened taste with which he selected from the various readings, contributed immediately and directly to the progress of mind and civilization. It was he who first printed Greek, and with very little abbreviation. The edition of *Aristotle's works*, published at Venice, from 1494 to 1498, will always be regarded as a curious typographical monument. The folio was the only size in use, a very inconvenient one. Aldus Manutius entertained the fortunate idea of substituting the elegant and convenient octavo. He introduced a character similar to handwriting, which was called *Aldius*, from his name, and was said to be an imitation of Petrarch's writing, and much superior to the heavy Gothic.

Aldus Manutius was, in truth, a sort of prodigy in his almost barbarous age, when literary acquirements were confined to a limited number of studious men. His zeal was really remarkable. Having been much disturbed in his learned researches by numerous idle acquaintances, he placed a notice upon his door, requesting visiters not to enter, except on business, and to take leave as soon as possible.

Who is not also acquainted with the name of Elzevir, or Elzevier, which has immortalized so many printers in Leyden and Amsterdam? The lovers of books will never forget that the republic of letters is in debt to this illustrious family for various editions of classic authors, which are masterpieces of typography, and especially remarkable for their small and delicate characters, and their general beauty of appearance, internal and external.

The numerous and learned family of Estienne, also rank high among the friends of printing. From the time of Henry Estienne, the first of the name, who died in 1520, and who may be looked upon as the inventor of the *errata*, down to that of Antoine Estienne, who died at the Hotêl Dieu, in Paris, in 1674, this family printed numerous works of distinction, and ennobled the art by a perfect knowledge of languages and belles lettres.

Robert Estienne, the most illustrious of them all, understood Latin, Greek, and Hebrew. The historian De Thou said of him "France owes more to Robert Estienne, for having improved the art of printing, than to her greatest captains, for having extended her territory." It is said that, in order to render his works more correct, he published the proofs, and liberally rewarded any one who would point out faults. The most distinguished of his editions are the Hebrew Bible, the Greek Testament, (in the printing of which, there is but one single mistake, one misplaced letter,) and his *Thesaurus Linguæ Latinæ*. Estienne enjoyed the protection of Francis the First, although he was a follower of Calvin. In the following reign, meeting with persecution, on this account, he retired to Geneva, where he died in 1559.

"The Estienne family," says a biographer, "have placed themselves at the head of printing, by the beauty and correctness of their published works." The most learned and illustrious men condescended to correct their proofs, and the erudite annalist of printing, Mattaire, wrote their history.

The Barbons, by their fine editions of classic authors, and

Christopher Plantin, by his magnificent Bible, called the Polyglott, did honour to the art of printing. The latter, who died in 1589, and bore the title of arch-printer to the King of Spain, neglected no means of bringing printing to perfection, never regarding expense as any obstacle to procuring beautiful characters, or learned correctors. It is even said that he made use of silver types.

In the last century, Italy gave birth to one whose glory rivalled that of the celebrated Aldus Manutius. This was Bodoni, immortalized by his fine and solid editions of the Greek and Latin classics. He was employed at Rome, in the *Propaganda Fides* printing establishment, in his youth, where he conceived the idea that printing was as highly susceptible of improvement as painting or statuary. Some years afterwards, he founded the printing establishment at Parma, which bears his name, and whence have issued so many admirable books; admirable for the clearness of the text, the beauty of the paper, and the elegant style which pervades them throughout.

Bodoni himself superintended the casting of the types used in his establishment, and reduced them to a size which was agreeable to the eye. Uniting science to skill, he corrected the proofs with the greatest care and attention; and nothing gave him greater grief than the discovery that any mistake, however slight, had been suffered to enter one of his books; so jealous was he of the reputation of his establishment, and deeply interested in the improvement of his art.

In the course of the 18th century, a new art offered great advantages to printing; advantages which, in some cases, tend greatly to advance its usefulness. We speak of the Stereotype, that is to say, the art of casting permanent plates of letters from a plaster cast, in which an exact representation of the types has been made. The first attempts at printing were, in fact, stereotypes made with solid plates, upon which all the characters included in a page were imprinted in relief. At the present day, the term is only applied to impressions made with plates of fused

type metal upon pages composed of ordinary characters, or those engraved upon copper in intaglio instead of relief.

After 1735, the printer Wallyre made use of stereotype fused plates. It is not, therefore, proper to ascribe the invention of this typographical process to William Ged, a jeweller in Edinburg, who, in printing his stereotype edition of Sallust in 1739, only improved upon the method long in use in France.

This art was still in a state of great imperfection when Firmin Didot, by processes of his own invention, gave it a more brilliant, and especially a more useful impulse. This was in 1797.

Didot's stereotype was at first applied, and with great success, to the logarithmic tables of Gallet, which by this means attained great accuracy. This skilful typographer executed, by the same process, the great decimal tables of the register of lands, prepared by a body of accomptants under the direction of M. Prony. Some time afterwards, improving upon his invention, he introduced a new and more simple kind of stereotype, with which he published editions of the French classics, which tended to keep up a taste for literature through all Europe. These are known by the name of stereotypes; a name given them by Firmin Didot himself, and which has been adopted into the French language.

Firmin Didot's services to the art of printing did not end here. The invention of beautiful characters in imitation of handwriting, did him great honour. In order to arrive at this result, he proposed to divide and to combine the diverse parts of letters, and groups of letters, so that, by means of an inclined mould, the points where these letters or parts of letters were joined, were not seen.

His father, Ambrose Didot, who invented the system of typographical punctuation, left his son a fine inheritance of glory, and he improved upon it much. It was from types cast by him that Pierre Didot, his brother and his rival, printed a magnificent Racine, pronounced by an assembly "*the finest typogra-*

phical monument of all places and all ages." He also did much towards the improvement of maps.

Although devoted to his art, Firmin Didot found time for literary occupations: as he said of himself,

"Sometimes I serve Vulcan, sometimes the nine sisters."

In his quiet retreat at Mesneil, near Dreux, where his venerated remains sleep, this studious man employed his leisure hours in the study of letters. And it may justly be said of him, that his compositions ranked as high as did his various improvements in printing. The opinion of an enlightened public decreed him a place in the *Academie Francaise.* But it is well known that merit alone will never open the doors of this academical Sanhedrim. Well were it, if more of its members possessed claims as solid or as brilliant as those of Firmin Didot.

His poetical translation of Virgil's Bucolics, of the Idyls of Theocritus, of Bion and of Moschus, that of Tyrtæus, and of some of Anacreon's poetry, and Sappho's, betray a profound and intimate knowledge of these old poets, and an uncommon skill in reproducing their beauties. His tragedy of *Hannibal* is in some parts not unworthy of Corneille; his *Inez de Castro* has superseded that by Lamotte, to which it is very superior, both as regards composition and style. It would be easy to extend the enumeration, but our work is not devoted to literature. We therefore return to the illustrious mechanic, and will show Firmin Didot to the reader in that capacity.

The following is a fragment of a letter, addressed by him to Ambroise Firmin Didot, a son of his, then travelling in Greece.

"I await your return with impatience, for I wish you to take part in a work which will tend in one respect to facilitate the instruction of youth. For our efforts should not be limited to the mere advancement of luxury, but be subservient to general utility. I have engraved and cast with care the types of the folio editions of Virgil and Horace, printed by Pierre Didot, my

brother, and those of the quarto edition of Camoens, which I have just printed; but I consider myself as having been more useful, by giving to the public a collection of logarithmic tables, which present now, and always will, as long as they are reprinted, an entire freedom from faults; and by increasing the use of stereotype editions, which are of a nature to sustain and propagate the love of reading; as well as by printing writing letters without any interruption, especially a running hand called *English*, which has been cast and printed in England, but without success. A process by means of which, modes of handwriting can be prepared at a low rate for the children of the poor. The execution of maps is a more difficult matter, but I hope to succeed in it, and await your return to begin it.

"I learn with great pleasure that you are desirous of engraving the oriental characters when you return. Whether this will be advantageous in a commercial point of view, is of no consequence; but it will, no doubt, do you honour, and contribute to improve your taste for the study of languages. It is to be hoped that you will avail yourself of the corrections made by François Ambroise Didot, your grandfather, and Pierre Didot, your uncle, in their editions of French and Latin authors."

This letter needs no commentary; the knowledge, the modesty of Firmin Didot, his disinterestedness, and his zeal for his art and for the public welfare, are perfectly apparent.

Another printer obtained a great name for his efforts in favour of the stereotype, towards 1802: this was Herhan. His methods were different from those of Firmin Didot; and his stereotype editions, although of much value, could not be compared, for execution, to those of his skilful rival.

CHAPTER XXXII.

WEIGHTS AND MEASURES.

UNIFORMITY of weights, measures, and money, dates its first establishment from the period of the French Revolution.

"Some few measures," says M. Charles Dupin, "from the frequency and universality of their use, were established by the concurrence of public opinion. Such were the measures of distances, of extent, of size, weight, time, and of venal value, or money."

These fundamental measures were fixed under the reign of Charlemagne.

After the death of this monarch, the supreme power falling into impotent hands, the empire was harassed by a rebellion, and feudal anarchy put unity to flight. Every province under the dominion of a great vassal, had its own money; every district, governed by a secondary vassal, had its local measures.

It may easily be imagined how much the general commerce of the kingdom suffered from this state of disorder, which became worse when monarchical rule regained the ascendency, and mercantile relations were extended and multiplied within as well as without.

Under the reign of Louis XI., the great vassals were vanquished, and all ancient France brought under the authority of one throne; and the States-general, convoked a few years afterwards, undertook a reformation in weights and coins, and, under their auspices, a uniform and regular system spread through all parts of France.

But, unfortunately, such was the want of balance in the

higher powers, that the decrees of this assembly were forgotten as soon as received by the court.

In 1789, the States-general, become a constituent assembly, went beyond the mere utterance of vain complaints upon the important subject of measures and coins. They consulted the Academy of Sciences, who twice replied to the appeal through its most illustrious members: such as Borda, Condorcet, Lagrange, Laplace, Lavoisier, Monge, &c.

They entertained just views concerning the alloy, and the true standard of money, and established the necessity of a uniform subdivision in all species of measures, according to the decimal progression of arithmetic; and, aspiring to the highest degree of public utility attainable by a system of measures, endeavoured to procure a basis in the invariable elements of nature; one which could be measured with itself, with a close approximation, and continue unchangeable through all ages.

After much hesitation, the circumference of a terrestrial meridian was fixed upon as this basis; and, in accordance with a decree of the National Assembly, operations were begun in defiance of all obstacles arising from the spirit of the age, or the ignorance of the people.

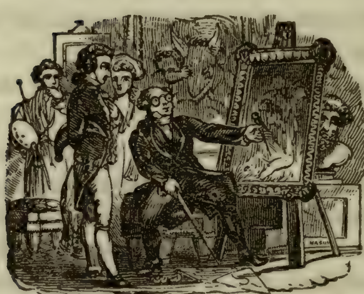
The following anecdote will give an idea of the force of prejudice at that time:—

The astronomer Mechain, one of those intrusted with measuring the meridian, was passing through Essone, a few leagues from Paris, when the municipal authority arrested him, under the strange idea that his instruments were so many secret agents of counter-revolution; and it was with the greatest difficulty that he obtained his liberty, and repaired to the southern part of the arc to be measured.

Shortly afterwards, a barbarism of the most odious nature re-established itself in France. The Academy of Sciences, and all other literary institutions were suppressed. Schools of all kinds were abolished in town and country; and the rising generation bid fair to become one of savages.

This deplorable condition could not be of long duration. The Convention endeavoured to remedy the disorder. After the death of Robespierre, restorative measures were attempted. A central school of public works was founded in Paris; encouragement afforded to artists and men of letters; normal establishments for forming professors and primary schools, created throughout all France. It was then that the above-mentioned new system of weights and measures made a part of public instruction, and spread slowly to the commercial relations. The Institute of France replaced the old academies, and the most illustrious men of the age became members.

Other useful establishments arose during this stormy epoch, among which may be mentioned the Conservatory of Arts and Trades.



CHAPTER XXXIII.

THE CONSERVATORY OF ARTS AND TRADES.

IN 1775, the celebrated Vaucanson laid the corner-stone of this artistical and scientific museum. At his death, he bequeathed his collection of machines, at the Hôtel de Mortagne, to the king. But it was not until the last century, when this establishment was removed to the old abbey of Saint Martin, that the Conservatory of Arts and Trades was regularly organized.

It is destined for the reception of models, in miniature or otherwise, of plans, designs, machines, utensils, instruments, &c., used in agriculture, in manufactories, &c. The object of collecting these in one place is to make them subservient to the further development of the arts.

The Conservatory of Arts and Trades was not always what it now is. At first it consisted merely of a few machines or models, picked up here and there. But the disorders of the Revolution transferred to this establishment the collection made by the Royal Academy of Sciences, and enriched it besides with spoils from private collections, placed at the disposal of the government by the odious law of confiscation. Other countries have also contributed to enlarge and embellish this exhibition, where may be seen the cabinet of the natural philosopher, Charles, the first in Europe, and also various models of inventions which have gained a patent; but these are not exposed to the public gaze until the expiration of the patent-right.

The ancient and time-honoured abbey of Saint Martin has undergone many changes since it was first founded in the eleventh century. The tower containing the great bells, which so loudly called believers to the services of the church, is no more. It

has disappeared with the great gate of the architecture of Henry the First's age. Time has destroyed them both; and in the eighteenth century the church was repaired, and ornamented by a new façade. The Revolution metamorphosed it into an exhibition of machines.

Let us take a hasty glance at the rooms or galleries of the Conservatory of Arts and Trades, some of which are on the ground-floor, others above.

The first room, which was formerly a part of the church, contains agricultural instruments, hand-mills, the vehicle which was used for the transportation, from Marly to Paris, of the fine marble horses which ornament the entrance to the Champs Elysées, and many other machines.

Another is filled with models and machines used in hydraulics and agriculture; pruning-knives, pickaxes, and other instruments, all sorts of water and wind-mills, pumps, and cooking apparatus.

A third room contains machines for carding, weaving and winding; another for dividing skins according to their thickness, &c. Farther on are exhibited coiners' stamps, flatters, machines for making weavers' warps, an improvement which is owing to Vaucanson, and machines for making screws.

The large apartments up-stairs contain models of all species of machines; such as reels, stocking-looms, locks, models of machines in which fire is used, and of ships, and the miniature representations of the work-shops of various mechanics; such as the locksmith, the carpenter, the potter, &c., executed by the directions of Madame de Genlis, for the instruction of the princes of the Orleans family. The best among this collection is, without exception, the turning-lathe of the unfortunate Louis XVI.; than which it is impossible to imagine a better constructed machine.

We must pass over the library connected with this establishment, which is open on Sunday and Thursday for the use of the labouring classes, and contains the rarest foreign and national

works on the subject of the mechanic arts. The importance and the utility of this establishment are annually increasing, and great ameliorations are successively introduced, of which we will point out a few before completing the statistical summary of the Conservatory of Arts and Trades.

This conservatory remained long in a state far beneath its original destination, receiving no additions, and opening the library only to those provided with a special permission from the director. The descriptions of many of the machines were unintelligible, and but one elementary school of drawing and arithmetic, for those past the age of childhood, was attached to it. This order of things has given place to one much better, in many respects. The old and useless articles have been substituted by machines and apparatus of modern date and application, and on a much more enlarged scale. The library, as we have said before, is open two days in the week. The little school has increased so that its plan of instruction embraces, in addition to arithmetic and the elements of drawing, the first principles of geometry, descriptive geometry, with its application to timber-work, stone-cutting, and the drawing of machines, ornaments, and diagrams.

This establishment is the habitual rendezvous of artisans desirous of instruction, either in the theory or the practice of their trades; and many learned professors, sincere friends to the popular arts, and to those who cultivate them, here devote themselves to mechanics, chemistry as applied to the arts, physics, and the study of machinery. Among these we must mention M. le Baron Charles Dupin, and M. Blanqué, the elder, both distinguished by their zeal for the improvement of the working classes, and who understand the enviable art of captivating their audience. But we are in advance of our subject. Let us return to complete our sketch of the great works carried on during the republican period.

CHAPTER XXXIV.

IRON BRIDGES.

IRON bridges, when introduced into France, proved to be of great importance, as this metal, possessing much more durability than timber, was more advantageous for the arches and parapets.

The merit of this innovation belongs to England. The first suspension bridge was thrown over the Warmouth river, in 1793: nevertheless, the invention is a French one; for it is said that a painter at Lyons, in the last century, conceived the idea of a suspension bridge two hundred and thirty-four feet long, and eighteen feet six inches broad. It was to have but one arch, and to take the place of the Saint Vincent Bridge, now existing at Lyons; but the plan was never put into practice. Another project of the same nature, presented, in 1783, to Louis XVI., by M. Vincent de Montpetit, met with the same fate.

But the example of the English was soon followed in France. In 1799, the engineer Brullé, undertook the construction of the Austerlitz Bridge, over the Seine, at Paris.

It was some years before this bridge was finished, under the direction of M. Lamandé, causeway and bridge inspector. It is composed of three arches, each thirty-two metres fifty centimetres span. The vaults are composed of cast iron, fastened together with platbands of hammered iron, and it will bear the heaviest vehicles.

At the same time, public attention was directed to canals; and those of Saint Quentin, Midi, Carcassone, Toulouse and Burgundy, and that connecting the Rhine with the Rhone, the Escaut with the Meuse, and the Meuse with the Rhine, were undertaken with vigour.

The Ourcq canal particularly deserves mention. Its construction was first proposed by Leonardo da Vinci, during his sojourn at the court of Francis I., and it was begun in part under Louis XIII., but not completed till long after.

The length of this canal is twenty-four leagues, its slope thirty-one fathoms. It is dug in the earth, without embankments, sluices, or locks. It receives the waters of the Beuvronne, the Therouanne, the Collinance, the Gergonne, and the Ourcq, and reaches the Villette basin in twenty-four hours, eighty-three feet above the lowest waters of the Seine; a volume of water containing 672,000 hogsheads. It was constructed under the direction of M. Girard, head canal and causeway engineer. "This is a model of navigation on a small scale, well applied to useful purposes," says M. Ferry; "but its plan would not be equally beneficial under less favourable circumstances, or in places where the influence of royal authority could not be procured, and where, in consequence, difficulties, moral and physical, would arise to impede the construction of the work, and where the original expense would be greater than the permanent advantages."

The history of the Ourcq canal is an instructive one, especially when we compare the facts to be gathered from it, with those attendant upon the construction of the New York canal, which is more than three hundred miles long.

The basin of La Villette, which receives the Ourcq canal on the north, was completed during the reign of Napoleon. Destined for a port to the canal and a reservoir to Paris, and giving to the Seine an intermediary navigation, by means of the Saint Martin and Saint Denis canals, this basin is an important one, as respects utility and ornament. Its form is a parallelogram, surrounded by masonry. Trees are planted on the banks, and in fine weather boating excursions are very frequent on this fine sheet of water, which is safe and convenient for amateur navigation. During the winter it forms an excellent skating ground; and is at all seasons the centre of an active commerce with Rouen and Havre, as well as with the departments of the north-west.

CHAPTER XXXV.

INFLUENCE OF CHAPTAL UPON THE ARTS.

CHAPTAL, an illustrious man of learning, a statesman, and at the same time a manufacturer, took an active part, not only in the scientific discoveries which distinguished the latter years of the republic, but also in the rapid progress of various branches of labour at that epoch.

A chemist from his earliest youth, he cultivated his favourite science with ardour, consecrating to it all his leisure hours; he spoke of it with an enthusiasm which was insensibly commu-

nicated to his hearers—with a lucidity and precision which caused him involuntarily to impart knowledge. "The more he learned," says one of his biographers, "the more he felt the littleness of his own learning." Wishing to enjoy greater advantages of instruction, he came to Paris, and some time after, a professorship of chemistry being created in Montpelier, he was appointed to it. His lectures attracted a numerous audience, and his *Elements of Chemistry* obtained a great name.

From that time (before the Revolution), Chaptal directed his attention particularly to the application of science; and his extensive knowledge procured him an admission into the order of Saint Michael, at the age of thirty. An uncle, a celebrated physician, called the *Curer* by the lower classes at Montpelier, left him 100,000 crowns, which Chaptal applied to the establishment of manufactories of chemical substances, of which France had at that time great need.

At the time of the revolutionary crisis, Chaptal wished to share the sufferings and perils of his country; although Spain, the kingdom of Naples, and the United States of America, entreated him to follow the universal example of emigration, and offered him each an asylum. Washington pressed him with generous cordiality, the Queen of Naples wrote to him with her own hand, and the Spanish government proposed to defray the expenses of establishing new manufactures. Chaptal declined all offers.

Called to Paris in 1793, by the Committee of Public Safety, he became the fellow-labourer of Berthollet, Monge, and Guyton de Morveau, and, together with this eminent body of men, contributed to deliver France from the dangers surrounding her. Paris henceforward became the scene of Chaptal's labours; he resided there from 1789, and continued to found manufactories of chemical substances in the neighbourhood of the capital.

Chaptal soon appeared under a new aspect. François de Neufchateau, an excellent minister, and one who deserved to live in a more propitious age, proposed to celebrate the sixth

anniversary of the Revolution, by an appeal to French industry. This was the first exhibition, properly so called, of French manufactures. But, as the whole affair was hastily got up, only one hundred and ten mechanics appeared at the rendezvous, all of whom were from the immediate neighbourhood, or from the department of the Seine, so that the exhibition was a poor one in every respect. It had, nevertheless, the advantage of creating a spirit of emulation, and pointing the way to farther improvements.

The following is an account of it, given by the judicious reporter of the exhibition of 1834, in his introduction.

The exhibition of the year 6, or 1798, deserves a particular mention, both in regard to its products and its deficiencies. Covered stalls were erected for the reception of manufactured articles, and citizens were invited to come and examine.

There was no silk to be seen; but cotton spinning attracted much attention. M. Denys de Luot (Seine et Oise) exhibited spun cotton, from the coarsest kind up to number one hundred and ten. This mechanic was one of the twelve who took the first rank.

The effect of the Revolution is revealed by the simple fact, that instead of aristocratic satins, laces, and brocades, the article which principally attracted public attention was that which once formed the cap of the lower classes, namely, cotton made with threads prepared at l'Epine, near Arpagon, and cotton velvet such as was then made at Amiens.

The judges of this meeting were well suited to the inauguration of French industry. They chose Chaptal for their reporter.

A new Revolution in France, prepared one in the mechanic arts also. The 18th of Brumaire, in the year 8, shone like an aurora over France. The Directory was abolished. The temporary consulate began, and the period of the empire was approaching.

In exchange for liberty, or let us rather say, for anarchy, the

genius of the age established order within, and victory without, and called into action all the talent of the country, making it subservient to the glory of France. Chaptal was intrusted with the prosperity of the interior, and never was a better choice made.

The services rendered to France by Chaptal, during a short ministry of three years, in respect to the mechanic arts, agriculture, manufactures, and commerce, are beyond computation, and offered a decisive proof of what can be effected by the rare union of scientific talent and ministerial capacity.

France conquered all continental Europe: but this was not all. An insular nation obtains a mastery over the ocean; through its commerce and productive arts it must struggle against adversity by the aid of its mechanical industry. This was the problem given by the first consul to his enlightened minister for solution.

Another appeal was made to French manufacturers, in the middle of the year 9; and towards the end of this year, a second exhibition took place in the Louvre, where preparations had been made on a very handsome scale.

Previous to the revolution, as well as subsequently, the finest woollens were manufactured from foreign fleece. After the year 9, French industry, under Chaptal's influence, succeeded in fabricating cloths of great beauty of texture, woven from the wool of Spanish sheep naturalized in France, and from French wool improved by a mixture with the merinos. One entire compartment in the Louvre was devoted to this branch of industry, giving the Parisians ocular demonstration that native wool is equal to that of Spain.

Chaptal's efforts did not end here. Upon his recommendation, the English mechanician, Douglass, left his own country, and established himself at Paris, where, in the space of two years, he furnished the sixteen departments with more than three hundred and forty machines for spinning and weaving wool; and in the year 10 (1802), thanks to the encouragement

afforded by the illustrious Chaptal, a third exhibition was held, showing the rapid progress of our manufactures, and where appeared beautiful stuffs, destined for the Levant; fine manufactures from Lyons; muslins embroidered in gold and silver, in a style equal to that of the finest oriental embroidery; silks and satins of great width, having both sides alike; and silks interwoven with gold and silver in exact imitation of needlework; as well as silk velvet of shaded scarlet, a colour never previously obtained on this material.

"It is repeated with an affectation of contempt for France," says M. Charles Dupin, "that the only article deemed worthy of admiration by Fox at the exhibition of the year X, was a small common knife for two sous. Fox should have reserved his admiration for the Castres cloth, the price of which varied from one to eighteen francs a yard, thus placing it within the reach of the middle and poorer classes.

"But we should take no heed of a sarcasm evidently inspired by national jealousy. Ambitious England, in spite of all pacific treaties, the eternal enemy of France, beheld, in our marvellous improvements, a blow aimed at her mechanical supremacy; perhaps she felt a presentiment of the continental blockade, and attempted a sort of anticipatory revenge, by showing a disdain too evidently affected, a bitterness too unjust to wound.

"Our expedition to Egypt, which brought us back so few political laurels, was more productive with respect to the arts and sciences."

Those of our readers who were born at the end of the last century, will remember that strange troop which spread over France, and filled the army upon its return. I can still fancy I see that fine company of Mamelukes, in their picturesque and imposing costumes; their majestic turbans, glittering vests and sabres, pistols, and poniards. They were a fine and bold race of men, well worthy to march side by side with the French regiments, where they shone, a glorious trophy of Napoleon's foreign exploits.

Close upon the heels of this swarthy troop, followed a new branch of industry, which may be looked upon as a conquest, and which met with great encouragement at the exhibition of 1802. I speak of the imitation of cachemire shawls, begun with Spanish wool, by the Terneaux family and their associates, Jobert Lucas and Madame Recicourt. Decrétot fabricated this article from French wool grown at Vigogne.

During the three years of his ministry, which were so well spent, and so much to the honour of France, Chaptal restored to its former condition the Gobelin establishment, which had declined during the Revolution. Among the numerous services he rendered to France, we must not omit many improvements in the art of making wine. He pointed out means of ameliorating its qualities; and proved that several demikilograms of sugar, white or brown, or saccharine matter in any form, extracted from fecula, will, without any noxious effects, produce a material change for the better in a hectolitre of wine, which, without this corrective, would have been sour and flat. So does science correct the imperfections of nature.

Twelve or fifteen years of so enlightened and intelligent a ministry as that of Chaptal, would have sufficed to double the resources of France. Few ministers deserve equal praise.

What immense improvements in the arts and in commerce since 1789! What astonishing inventions! What numerous changes have taken place during that period of innovation! What numbers of illustrious names have passed in rapid review! Every science, every one of the mechanical arts has its leader; and of these, the crowd is so great that only those who have pressed forward into the first ranks can be enumerated; indeed, after any brilliant action, which does honour to the valour of a whole regiment, it is enough to inscribe in the bulletins the names of those who led them on to battle.

In less than fifteen years, science, and most of the arts and trades improved and enlightened by it, have become the subjects of prodigies of advancement, which, in former ages,

would have been considered as beyond the limits of possibility, and which will, in all nations, obtain the homage of posterity.

In less than fifty years also, has France undergone many and bloody trials; the precursors of a freedom which, when still in its infancy, appeared ready to die from repletion. We have already made mention of the situation of the country at that fatal epoch. Banishments, massacres, scenes of disorder abounded on all sides, and, to borrow the energetic expression of a modern philosopher, "the hollow cracking of the vast social edifice was heard on all sides as it tottered and fell. Ruins fell in a sea of blood, which, in its turn, inundated the ruins." What a series of horrible scenes, the memory of which all wish to leave in obscurity! What terror invested the workmen of the Revolution, who, boldly looking upon society as a block of marble, endeavoured to hew out the statue, partly revealed to them by a distorted imagination! The ancient monarchy, with all its privileges clinging around it, was overturned, and succeeded by anarchy, with its disastrous consequences. In the place of a king, whose only fault was his excessive goodness, and who was assassinated as a tyrant, there arose hundreds of bloodthirsty tyrants, who reigned by aid of the guillotine over a terrified and fanatic people.

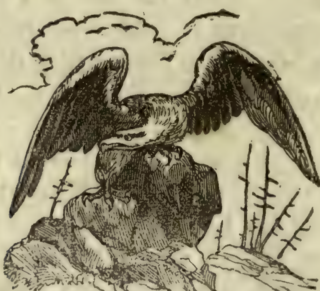
"All laws were abolished," says M. Ballanche, "and the people hoped to institute new ones. They spoke of creating society, as if society had never existed. Experience, tradition, custom, all disappeared before the face of a chaos of human reveries, of the conceptions of pride freed from all restraints. No such thing was heard of as interrogating the past with wisdom and prudence, and obtaining from it a guide to the future; France was herself forgotten; all proportions suddenly destroyed; the horizon had no known limits, and the lowest and most ignorant mechanic talked loudly of organizing the human race."

From the bold and firm hands of the National Convention, the reins of government fell into those of the weak and powerless Directory. The French republic felt that, notwithstanding the

success of its army, there was no safety but in energetic union. Like Rome of old, in the days of imminent peril, she felt the necessity for a dictator—she found an imperious master. But that is a great historical fact, which belongs to another epoch.

Here terminates the first period which I indicated in beginning my historical sketch of the heroes of the arts, the glories of the manufactory and of the work-shop. I have recorded all the wonders that have arisen among us, in spite of the horrible internal ravages which have threatened to destroy France. Now, renewing her energy, as her wounds closed, she is about to offer us new leaves culled in the field of arts, although the battle-thunder echoes even there.

A genius whose powers were of the first order; whose views were powerful and extended, and whose will became a law to all, took the government of France into his own hands, and gave it a new and glorious character, hitherto unknown to it. A modern Charlemagne,—he astonished the world by the greatness of his exploits. His noble ambition longed to conquer other nations; not only at the bloody game of battles, but in the pacific arena of the arts. France beheld him, in the same day, organize a victory, establish laws, and found manufactories. Already do I behold the eagle, symbol of his high destinies and his invincible strength, spread his majestic wings to the horizon, and hover, with august pride, over the trophies of war and industry, united for the first time.



CHAPTER XXXVI.

NAPOLEON.

THE period which beheld the French empire arise from the midst of the bloody ruins of the ancient monarchy, presents a phenomenon which seems almost magical, and which, like all strange events, is of a nature to excite the sympathy and admiration of the people in a high degree.

The empire, with its peculiar physiognomy, its colossal size, its ten years, containing more than many centuries, now appears in history like one of those granite pyramids which raise their tall majestic heads from among the sands of Egypt, indestructible monuments, against which the scythe of time but dulls itself! All the universe is acquainted with the name of the hero of this memorable epoch, a name which, to this day, is in the thoughts of all who occupy an elevated political station; a name which will always exercise a magic influence under the thatch, as well as in the work-shop; for in all future ages, the people will remember with pride the exploits of the illustrious captain, who, himself one of the people, enchained factions, gave his own laws to vanquished nations, and raised his throne upon those of all Europe, causing a new glory to spread over France; a glory, with which he associated all the brave men, worthy descendants of the ancient Gauls; a glory, in some sort of plebeian origin, but noble, pure, and brilliant, and of which, but few families may not lay claim to a part.

This glory was the patrimony of all, of the poor even more

than the rich, and courage and personal merit were its only requisites. This circumstance explains the almost contagious action exerted by its memory upon the mass of the people, and will also powerfully contribute to perpetuate its remembrance; for in future, the people will never behold any thing more heroic than the great battles of the empire, more courageous than the warriors and soldiers of the *grande armee.*

The extraordinary man who was the soul of this memorable epoch, was born at Ajaccio, in Corsica. His father was a gentleman of no rank or fortune. From him he received the name of Bonaparte, and from his godfather and godmother, that of Napoleon, two names under which he immortalized himself, first as general, afterwards as emperor.

The name Napoleon, which signifies *Lion of the desert*, and thereby appears symbolical, is an admirable summary of all the greatness of the empire.

An anecdote is related of the childhood of Napoleon Bonaparte, which may since have been looked upon as an omen of his marvellous after-life. During the early part of his childhood, his sole instructor was one of his great-uncles, an archdeacon of Ajaccio, who was remarkably fond of him. One day, at the residence of this good man, a beam broke and fell with a loud crash. The whole household fled in terror and consternation, with the exception of a child who was on the spot, and who, far from seeking to avoid the danger, sprang forward, by a strange impulse, and extended his little arms to catch and support the falling timber. "Well done," exclaimed the old man, embracing the little Napoleon, "I see you are destined to be the prop of my house."

Not long afterwards, the venerable archdeacon, being on his death-bed, said to the young members of the Bonaparte family, who were asking his blessing:—"It is useless to feel any anxiety concerning the future fate of Napoleon; he will make it himself. Joseph, you are the eldest of your family, but Napoleon is its head, mark my words."

Every one knows to what extent this prediction has been verified. At the age of thirty, Napoleon was not only the head of his family, but the supreme umpire of Europe. His victories in Italy, his adventurous and brilliant expedition into Egypt, the glorious treaties of Campo Formio (1797) and of Amiens, (1802,) opened to him the road to power. Chosen consul for life of the French republic, on the 2d of August, 1802, he gained in less than two years, the title of Emperor of the French, and constituted himself the founder of a new dynasty, which only needed the consecration of the past to be sure of the future.

I shall not enter into a description of the great events which made up the life of this remarkable man: these details, otherwise so interesting, would lead us too far from our subject. But we shall be pardoned for pausing an instant before the pedestal of the hero who, in modern times, could be, by turns, Cæsar and Charlemagne.

"Every thing is homeric," says an eloquent biographer. "Every thing in this illustrious life seems vast and sublime to the man who muses upon Napoleon's course from the island where he was born, to the one which afforded him a grave; a bright and terrible star which rose from the bosom of the ocean, passed from the east to the west, and returned thither to sink forever! However, in this instance, it is the true which becomes the strange: this extraordinary destiny has been accomplished in the midst of us all; his career was a drama in which we have all been either actors or spectators. But were either the actors or the spectators of these events to attempt a description of them, we should fancy it to be an epic poem unfolded before us. Bonaparte's face is imprinted among my childhood's earliest recollections. I belong to one of the generations which have ripened in the sun of his prosperity. In his hour of adversity, I have seen him in those fatal marches where he retreated from battle to battle, under the combined forces of the whole world. And when I have occasion to recall the names of Arcola, Cairo, Marengo, Austerlitz, Jena, Friedland, Wagram, and Mojaisk,

during the fame of which, our youth passed by, I am on the point of entitling my chapters, Songs of the Youth of Napoleon; Songs of his Italian Campaign; Songs of the Egyptian War; Songs of the Consulship; Songs of the Empire, up to its summit of power, and thence downward to its decline; Songs of the Island of Elba; and, finally, of the one hundred days of Saint Helena! It is the Iliad of the modern glories; an Odyssey comprising all nations and all shores. But what fiction could compare with such facts? They bear upon them the stamp of greatness so evidently, that admiration is aroused without any aid from the imagination; nor does our proximity interfere with the sublimity of the impression made. Napoleon had the rare good fortune to appear a Colossus even in the eyes of his cotemporaries. Such has he remained even to his most severe judges, his harshest critics.

A captain, a conqueror, a legislator, Napoleon added to these high and rarely united qualities, the difficult art of administering the government of a vast empire. He was not forgetful, in the splendour of his victories, of the industry of France; his genius knew how to direct, and followed with a true pride the vital developements of manufactures and the arts. The two exhibitions which he instituted during his consulship, one in 1802, and the other in 1803, betrayed from the beginning his solicitude for the commercial prosperity of France.

Shortly afterwards, when he placed upon his head the imperial crown, he wished for the commercial, as well as political interest, to give his coronation a solemnity suited to his sovereign power, and to the resources of the country.

This imposing ceremony, in which, to the great astonishment of the public, the illustrious Pius VII. took a part, gave a vigorous impulse to our manufactures. It offered the grand and magnificent sight of a court formed as if by enchantment. The new emperor, struck with the idea that a great and rich people require arts which are adapted to wealth, in order to give the means of existence to a large part of the population, supported otherwise by agriculture alone, was desirous that all

the workmen of all classes should unite to revive the beautiful arts which had formerly flourished at Lyons, at Tours, and at Avignon. Thence have issued so many rich and variegated costumes, beautiful productions of taste and elegance, all perfectly appropriate to the different ranks of the new hierarchial government, all attesting the renovation and improvement of the arts, and heightening the pomp of the solemn coronation. All this had been previously arranged and decided upon, after mature reflection, by the supreme chief of the state. In order to achieve a conquest over all minds and all hearts, it was important to fascinate the multitude by an imposing scene, which from beginning to end would forcibly exhibit the splendour and power of the imperial throne.

The 2d of December, 1804, occupies an important place in the annals of the French revolution.

Those of our contemporaries who have lived half a century, can recollect the spontaneous enthusiasm with which the people greeted the brilliant dawn of the new reign. What excitement! what joy! in all classes interested in the re-establishment of order! It was in fact a popular festival. Mechanics, especially all those so truly important to the progress of manufactures, exhibited the liveliest transports. One great reason of all this was, that, among the high dignitaries of the court organized on the field of battle, they were able to recognise many men, like themselves of humble origin—many who, brought up in the workshop, were, so to speak, their former companions.

Thus, the mechanic of the suburbs and the plebeian recalled with honest pride the humble departure of each of those great persons, now clothed in gold and embroidery, ornamented with ribands and orders, military and civil insignia, and wearing with such grace the court cloak, and the plumed hat, as well as the equally novel titles of prince, count, and duke, titles revived from the old monarchy, and which were in some degree the certificates of their fame. The heroes composing the young imperial nobility, early accustomed to the heat of the cannon

and the noise of grape, had for the most part quitted the dress of a mechanic for that of a soldier, and, as they rapidly rose to distinction, proved themselves the offspring of their own actions.

There was Eugene Beauharnais, the Bayard of our day, who gave up the apprentice's apron, and claimed his father's sword after the death of the latter upon the revolutionary scaffold. Napoleon, touched with his filial affection, adopted this young man as his son, who was soon to be viceroy of Italy.

There was Joachim Murat, the heroic swordsman, son of an innkeeper of La Bastide, near Cahors, who afterwards became marshal of the empire, prince, high admiral, grand duke of Berg, and brother-in-law to the emperor, and who obtained, unfortunately for himself and France, a seat upon the throne of Naples.

There was Augereau, the former master-at-arms, son of a fruit-woman of the Faubourg Saint Marceau, justly celebrated as one of our most brilliant military characters. The glorious part which he took at Lodi, at Castiglione, and at the passage of the bridge of Arcola, placed him in the highest rank among the generals of the republic, and raised him to the high offices of Marshal of the Empire, and Duke of Castiglione.

There was Michel Ney,—he who, sprung from an obscure family of Sarrelouis, found, as the story is, a Marshal's staff in his cartouche-box. Already Duke of Elchingen, he won, at a later period, not only the title of Prince of Moscow, but one still more honourable,—one given him by Napoleon himself: namely, that of the *bravest of the brave*, a name by which he will always be distinguished in history.

In this ceremony of the coronation appeared, among other military personages, the Marshal, Prince of Porto Carro, twenty years before a private soldier in a regiment of infantry, now King of Sweden and Norway, under the name of Charles John the Fourteenth. He was born of a plebeian family of Bearn, and became illustrious as Bernadotte.

Finally, to terminate this brilliant enumeration, which could

easily be extended, let us conclude with the mention of the celebrated Marshal Lannes, Duke of Montebello, who is more intimately connected with our nation.

Son of an hostler, and a native of Lectoure, Lannes passed the first years of his youth in an apprenticeship to a dyer of Auch. From this station his next step was to the highest dignities of the empire.

Two incidents are related which are equally honourable to his head and his heart. Already at the summit of military honour, and about to take the command of a division of the army in Spain, he was obliged to pass through his native province. Many, through vanity, would have preferred taking another route, in order to avoid meeting old acquaintances, whose presence might be troublesome; or else, actuated by a still more silly and not less uncommon vanity, might not have wished to appear among them otherwise than surrounded by all the imposing dignities of a new and elevated station, an ostentation which generally fails in its object. The Marshal, Duke of Montebello, showed himself truly worthy of his elevation by pursuing an entirely opposite course of conduct, and left in Auch a remembrance never to be effaced from the minds of the people.

Arrived at the gates of the city, he chanced to see a labourer employed in mending the road, and recognised in him a former playfellow. He stopped his carriage, got out, and going up to the man, said, in the *patois* of the place,

"Well! comrade, don't you think fighting with the Austrians is a better business than the one you are at? Don't you know me?—look close!—not yet?—shake hands, come!"

And so saying, he, the Marshal of France, the Duke of Montebello, the distinguished officer, the friend of Napoleon, affectionately pressed the callous hand of the labourer, who stared in astonishment.

"Come!" said the marshal, "it seems to me you have not risen in the world; perhaps you do not like the smell of gun-

powder; how will trade suit you?—very well, will it not?—I will see to it for you."

The next day, thanks to the generous exertions of Lannes, the poor man found himself in possession of a pretty little shop.

Arrived at Auch, the Duke of Montebello was obliged to go through the usual routine of official visits. Nevertheless, his first thoughts were for the dyer Dulau, his former master, whom he sent for immediately upon leaving his carriage. He was conversing with this worthy man when the civil and military authorities, headed by the Prefect of the Department, who had come to offer the marshal a complimentary dinner, were introduced. The hardy dyer, somewhat uneasy at the sight of so many robes of ceremony, and fearing he might be *de trop*, wished to retire; but Lannes, drawing his arm within his own, prevented this, and leading him forward, said to the magistrate who had just spoken:—

"Sir Prefect, I accept with pleasure the dinner you offer me, but upon condition of bringing with me the worthy man whom you here behold."

Let us add, in concluding this recital, that during the whole evening, the marshal overwhelmed his former master with attentions. An aristocrat of the present day would no doubt blame such very marked gratitude; thinking, that a marshal of France should maintain the dignity of his station, and not condescend to familiar intercourse with those who are far beneath him. . . . Beneath him!—I appeal to every right-thinking and generous mind, is not such condescension the true self-exaltation?

This noble disposition made Lannes beloved by the whole army, from the common soldier up to the emperor. The universal grief betrayed when the intrepid marshal received his death-wound at the battle of Essling, was a proof of this. Napoleon himself hastened to the dismal hand-barrow on which was extended the mutilated form of his illustrious lieutenant; he threw himself upon the bosom of his friend, who had fainted from loss of blood. "Lannes," cried he, "Lannes, look up; it

Death of Lannes.

is your friend! it is the emperor.—it is Bonaparte,—your friend!" The Duke of Montebello opened his eyes, recognised Napoleon, and their distress was mutual. "In a few hours," said Lannes, in a dying voice, "you will have lost the man who loved you most."

This man, who was not ashamed of having been a dyer's apprentice, had always the courage to speak the truth, without reservation, to Napoleon. He was the worthy Hephæstion of this second Alexander, and well deserved the honours decreed to him at the Pantheon on the 6th of July, 1810.

I had already observed that the ceremony of the coronation had served to bring to light many new resources of French industry. The formation of the new court opened an extensive market for manufactured articles.

The exhibitions which have been spoken of in the period preceding this had been the cause of great improvements in various mechanical arts. The enlightened administration of Chaptal had contributed in no slight degree to prepare and to secure these fortunate results; and, to say the truth, the skilful minister of

the interior had the good fortune to find an able coadjutor in the emperor.

This opinion, which, however, has never been contested, is clearly manifested in the following passage from the Baron Charles Dupin. "What a glorious epoch was that," says the learned academician, "when the very great man who preferred the title of member of the Institute to that of general, visited, in company with his illustrious friends, Berthollet the chemist, Monge the geometrician, and the minister Chaptal, the workshops and the manufactories of Paris, Rouen, Lyons, Milan, Bruxelles, Liege, and Aix la Chapelle; urged everywhere the necessity for improvement; searched with his eagle eye into the mysteries of mechanical ingenuity; roused and stimulated the indolent with his memorable and cutting language; and gave to his praise the charm of professional, of universal renown! Did he meet in his course with a man of talent, a Terneaux, a master-builder of uncommon genius, he disengaged the cross of honour from his own breast to place it upon that of the artisan with his own hand, in the presence of all the apprentices and workmen."

In this manner this great man encouraged the sciences, the arts, and the people. Happy for him, if his ambition had not carried him far from that people and its interests, to seek in endless wars the grave of his fortune and his dictatorship.

The first years of the empire, the brilliant continuation of the consulship, were fortunate years for the commerce and manufactures of our capital and our provinces. Although the war might oblige France to maintain numerous armies, yet, as it did not fail to crown all Napoleon's enterprises with success, and daily to increase his power, and the universal confidence in his genius and his good fortune, a prodigious activity became remarkable in our manufacturing towns, and in our work-shops generally.

In every direction, success and prosperity crowned this industry. As if by enchantment, the number of our cloth manufactories began to increase, together with that of the different

Napoleon and Terneaux.

trades, and the workmen employed in them. Wealth and ease having become more diffused and more universal, the demand for woollen stuffs, especially those of the finer sort, increased. Calicoes were also multiplied, but did not interfere with the use of native hemp and flax. Ingenious machinery carried cotton spinning to a great degree of perfection. Government had offered a prize of a million of francs to the inventor of a mechanism suitable for advancing flax-spinning in an equal manner, and thereby diminish the expense of the hand-labour requisite for working up the raw material.

Here, then, was one of the happy consequences of order, re-established first in the different departments of the empire, and afterwards in the immense number of minds which had been so long unsettled by political theories, more or less revolutionary. The erection of the imperial throne seemed indefinitely to postpone the hopes of faction. Whilst our brave soldiers abroad, under their hitherto invincible commander, were gaining victories, taking cities, subjugating kingdoms, making and unmaking kings, our workmen at home were making the anvil resound,

polishing iron and steel, fashioning wood, weaving flax and hemp, fabricating stuffs of woollen and silk, and inventing new and labour-saving machines, some more ingenious and complicated, others more expeditious and economical. Every artisan had returned to his former state of mind, one far better for the interests of himself and society at large, than the wild, fanatical spirit for a time let loose upon all France. There were no more meetings of the people, no more of those clubs open to the advantage of the worst passions, and where intrigue of the lowest stamp, idleness and blind sedition played so calamitous and ignoble a part. The daily papers began to be examined for the official accounts of victories. The Brutuses of the suburbs, Scævolas of the ale-houses, and the Catilines of the drinking-clubs, changed the style of their conversation; for the great and glorious name of Napoleon was in every mouth. Such changes came as if by enchantment. Women also, following the general example, returned of their own accord to their proper employments, their domestic duties, and the mild and feminine habits which they had done ill to part with. They began to worship the hero who presided over the destinies of the empire, and made public their extreme admiration for him on all occasions. No fear now of one single Charlotte Corday; a few years had uprooted all the republican feeling, or rather fanaticism, which had armed the interesting heroine of Saint Saturnin with the knife which gave the death-blow to Marat, of execrable memory.

At length liberty, or rather the odious tyranny which had so long usurped her holy name, fatigued with its own ignoble excesses, its hideous and bloody orgies, had fallen asleep in the bosom of glory; and France, under the powerful hand which guided her, had recovered the noble and prosperous attitude of a truly sovereign nation, and began justly to regard herself as in some degree the metropolis of the whole world, in respect either to the power of her arms, or the excellence, good taste, and perfection of the productions of her manufacturers.

The liberal encouragement given to workmen in the useful

arts, and the valuable rewards instituted to excite and maintain the emulation and perseverance of inventors, exercised a salutary influence upon the various manufactories.

Under the direction of Napoleon, the beautiful art of mosaic work, invented by the Greeks, and since exercised by the Italians, took its place as one of the French arts. In order to introduce it among us, the emperor sent to Rome for the artist Belloni, and intrusted to him the direction of a mosaic establishment. Strange to say, the skilful Italian instructed young blind men in this art. In this establishment they did not make use of the small cubes of polished stone, to be seen in some antique mosaics, but enamels were employed, such as are found in some Gothic mosaics.

About the same time, a new sort of earthenware, commonly known as *pipe-clay*, was made to undergo great improvements in France. This substance, finer than the earthenware produced at Sceaux, was introduced into France immediately after the peace with America. Hall, an Englishman, was the first who manufactured it at his establishment at Montereau. At one of the first exhibitions, he received one of the twelve prizes of the first class, given to great improvements in the arts; and since then, factories of the same kind have been successively established at Paris, Choisy, Chanteuil, Creil, and afterwards at Toulouse and Larreguemines, some of which have given to the world improvements which we shall mention hereafter, when our subject reaches the period which followed the empire.

CHAPTER XXXVII.

SHAWLS.

WE have already had occasion to mention, casually, the name of Terneaux, one of our greatest and most patriotic manufacturers.

During the consulship, this industrious man rose with difficulty from the misfortunes occasioned by the ruin of his manufactory, of himself and his family; nevertheless, after 1801, he restored to their former high rank the cloths of Sedan, Rheims, and Verviers; and employed as many as five thousand labourers in the perfecting of the beautiful articles to which his attention was directed.

Further, the indefatigable Terneaux, admirably seconded by his brother, had acquired a true claim to the national gratitude, by importing the Thibet goats into France, at a great expense, thus enabling us to imitate the valuable India shawls, and delivering us from a very burdensome tribute, hitherto paid to the Asiatic kingdoms.

It will be evident that we here refer to the French cashmeres, now so common and beautiful.

"What," asks a somewhat sarcastic observer, "were the shawls which, towards the end of the last century, covered the shoulders and the breasts of our ladies of rank?—handkerchiefs of plain or printed muslin, silk scarfs, or silk mixed with cotton, or gauze with satin borders, or square pieces of woollen stuff of coarse texture, plain or ornamented with little bunches of flowers, the most valuable of which were only worth a louis, and which no one would dare to offer at the present day to a servant. With such rags our shivering belles covered their shoulders,

when returning from a ball. Such shawls would scarcely protect them from the cold, wearing, as they did, thin dresses in the Grecian style, with short tight sleeves, without lining, and having in use none of the numerous modern comfortable articles of clothing. But it was the fashion to be frozen, and never warmly clad in public. Furred coats and muffs were forgotten and left to the moths; cloaks as yet unknown. The little shawl took the place of all these abroad. The wadded silk dress was reserved for the boudoir and the fireside; a few prudent women clothed themselves with it, when returning home at night.

About that time, the cashmere shawls were only known in France by name; and according to the descriptions of travellers, the wives of our ambassadors and consuls in the east, who received them sometimes as presents, preserved them as mere objects of curiosity. Indeed, these productions of Asiatic industry were held in very little repute. It is related that, in 1788, some ladies, to whom real cashmere shawls were presented, looked upon them with contempt, as in the light of serge, good, at the most, for lining dresses; others made dressing-gowns, ironing-blankets, hearth-rugs, &c., of them.

But an entire revolution soon came to pass on this point, in consequence, as we have already said, of our celebrated expedition into Egypt. Our warriors, upon their return from that distant shore, made these shawls better known, and brought them into fashion.

This pacific revolution contributed powerfully to the progress of industry, and gave birth to many new manufactories, the number of which has since so much increased over all France. The exhibition of 1801 displayed the first shawls, the imitations of India cashmeres, which were very far from perfection. The Vienna shawls being more brilliant, and printed in six or seven colours on a striped ground of cotton, excited the emulation of the French manufacturers, who soon succeeded in imitating them.

Finally, the public exhibition of 1806, at the Bourbon palace, offered to view a shawl a yard and a quarter square, with a border an inch and a half broad, ornamented with a circle of roses in the centre, and a scarf of silk and woollen, having a white ground, and a border three-quarters of an inch wide, and at each end palm figures nine inches high. Great efforts were now made to bring the spinning of wool to perfection, and the French manufacturers did not hesitate to risk a great amount of capital in order to improve, to vary and increase the productions of a branch of industry which was beginning to be patronized by fashion.

At the head of all the fabrics of this kind, were those of Terneaux, who made himself remarkable by the astonishing superiority of the shawls which have since taken his name.

It was not, however, until after much trouble and many sacrifices, that Terneaux succeeded in obtaining these brilliant results.

The cashmere shawl of India, the ornament of the Bayadere, the dress of the Brahmin, and which sometimes formed the turban of Mongolian or Mahrattan officers, had excited an extravagant admiration on the part of our French ladies. But the secret of its fabrication was unknown; no one knew what was the original material of this precious tissue. It was asked, and is yet, whether it was the wool of sheep, or the hair of any particular species of goat or camel. This is a question on which historians, scholars, travellers, and manufacturers, have never agreed. "All that relates to the fabrication of the cashmere shawls," says the above-mentioned author, "the mode of spinning and weaving, the form of the machinery used, the method of shading the colours, arranging the design, the flowers and palm leaves, as well as the ground on the borders, is still a mystery, not less impenetrable than that of the original material, and which could not be discovered by Berneir, Forster, or Legoux, who visited Cashmere, nor by any modern travellers in India; none of whom, indeed, thought it of much importance, not being

much interested in the subject of manufactures. One thing is certain, that the largest and most beautiful shawls, especially the long ones, are made by two workmen, and are in two pieces, joined together with remarkable skill. The large and elegant borders are put on in the same manner.

The noble ambition of rivalling the perfection of these Serinagor tissues, stimulated Terneaux to make the greatest sacrifices in order to acclimate the Thibet goats in France. This goat is a species existing from the frontiers of China to the Caspian sea, and bears the valuable hair thought suitable for the fabrication of the India shawls. But this speculation did not succeed.

The so-called Thibet goats scarcely afforded wool to the value of thirty sous a year, which was far from making up the cost of their maintenance. It became, therefore, expedient to abandon this scheme, and to import from Russia the fine wool which has contributed to give such excellence to the fabrication of French shawls.

Since then, the productions of our manufacturers have not only almost equalled in delicacy those brought from India, but have even surpassed them in elegance and variety of design. Let us add, that they are ten or twelve per cent. cheaper than those shawls, and that, in this respect, the last exhibitions of arts have been able to convince the most incredulous.

To complete the praises of Terneaux, we will quote the following passage from the *New Dictionary of Inventions and Discoveries*, article *Merinos*, which is itself extracted from the *Dictionary of Discoveries in France.*

"Terneaux fabricated the stuffs called merinos, and the genuine cashmere shawls, in the manufacture of which, he was unable to succeed until after much research into the unknown substance of the filaceous material used. Terneaux's efforts in this sort of labour were so fortunate in the end, that he surpassed the India fabrics, both in the wearing and the colours."

Terneaux won the gold medal, the highest prize, at six suc-

cessive exhibitions. He effectually encouraged all the manufacturing improvements, and engaged in commerce with the same energy which he displayed in his manufactures. There were at Cadiz, Leghorn, Naples, and Saint Petersburg, houses established by him, branches of his central establishment. His productions were superior to those of other European nations, without excepting the English. The exportation of these productions has increased tenfold since 1814, and, at the present day, exceeds in value 10,000,000 francs. In short, Terneaux has enjoyed the honour of being the one among the French manufacturers who has done the most to increase the national wealth, the revenue of the public treasury, and the well-being of the lower classes.

The following is a short extract from M. Blanqué, senior, who fully confirms all that we have said concerning Terneaux's influence upon our manufactures and commerce. Although the name of that great builder of manufactories is not mentioned in this passage, his eulogium is implicitly contained in it, for it is to him that are justly due the immense results signalized in these times.

"It is proper to observe," says the learned professor of the Conservatory of Arts and Trades, "that the greater part of our exportations consists of the great variety of articles of luxury and taste, which, standing as they do in the highest rank in the vocabulary of arts, do not the less figure among the sources of our wealth. Who, for instance, is ignorant of the high reputation of our shawls, which rival those of India, excelling them in delicacy of tissue, fineness of material, and frequently in stability of colouring? Less than thirty years ago, this beautiful art scarcely existed, while it now brings France a revenue of more than 25,000,000 francs. Smugglers introduced the first models, but our manufacturers soon bid defiance to these contraband articles. The names of Demirouse, Gaussen, and Hebert, have acquired great celebrity in this line all over Europe; and Eng-

land, so proud of her woven stuffs, is here obliged to acknowledge the superiority of the French goods, for we consider the manufacture of shawls as entirely nationalized in France. Our designers have in no small degree contributed to the riches of the country, and it is one of the most brilliant conquests made by us since the beginning of the nineteenth century."

CHAPTER XXXVIII.

THE SIMPLON AND MONT CÉNIS.

AMONG the great public works executed during the first years of the empire, the most astonishing were, without doubt, in regard to difficulties vanquished, the roads of Mont Cénis and of the Simplon, which were constructed upon the bold plan of the engineer Céard.

The military movements of our victorious armies during the memorable campaigns in Italy, had created a necessity for these great and important labours. At that time both Mont Cénis and the Simplon were as yet only furrowed by the foot-paths worn by the country people. Napoleon spoke, and the most magnificent roads that ever existed were opened to astonished travellers.

I will borrow from the *Annuaire of the Bureau of Longitudes,* for the year 1809, a few details which will give an idea of these admirable roads, where nature and art strike the imagination by turns.

In the passage of Mont Cénis it was necessary, from the bridge of Lanslebourg up to the summit near Ramasse, to ascend to a distance of six hundred and ninety-two metres, on a horizontal and direct length of two thousand eight hundred and fifty-five metres. Six winding slopes have reduced this abrupt declivity to a gentle descent, over which carriages of all sizes can easily ascend and descend, passing over a space of ten thousand two hundred and twelve metres. The whole descent on the Suze side is one thousand four hundred and fifty metres in height, on a horizontal and direct length of seventeen thousand eight hundred and sixty-six metres; the whole distance tra-

versed in the length of these slopes twenty-five thousand six hundred and sixty-three metres. The southern side of the mountain, although its declivity is not so steep, has presented difficulties at least equal to those of the northern. The whole road travelled over between Lanslebourg and Suze, which is thirty-five thousand eight hundred and sixty-five metres long, only exceeds by little more than one-fifth in length, the old road, which was only fit for beasts of burden, and was twenty-seven thousand nine hundred and fifty-six metres long. An extensive hospital has been erected on the table-land of this mountain, and inducements have been offered to all those who would take up their residence in this vicinity.

The barbarous condition of the greater part of the former road crossing the district of Mont Blanc, which was not only inconvenient, but also dangerous in some places, being inconsistent with the magnificent improvements on Mont Cénis, repairs were made in it whenever it was necessary. The passage of the *Echelles*, as it is called, which has been so much boasted of, and which the lightest carriages were unable to cross without additional horses, was replaced by a subterranean gallery, which has removed all difficulties.

Proceeding from Glitz, on the French side, to cross the Simplon, one meets with an elevation of one thousand three hundred and four metres up to the highest point, where it has been intended to build a hospital, travelling over a gradual descent of twenty-two thousand five hundred metres, the horizontal and direct length being ten thousand four hundred and ninety metres. The village of Simplon, which is situated at the distance of nine thousand three hundred metres from the Italian side, is lower than that point by five hundred and fifty-two metres. The works of art, consisting of propped walls, bridges, and subterranean galleries, are on a more extensive scale on this road than on that of Mont Cénis.

During the execution of these vast works, worthy to be compared with the most wonderful monuments of the ancients, a

military spirit was more and more diffused throughout the nation by the reports of our victories. In all the work-shops nothing was heard but animated accounts of battles and skirmishes. Far from dreading the hour which was to enrol them under the banner, the young mechanics considered it a festival to go in search of their share of the laurels reserved for the brave; and, as if to prepare themselves in advance for warlike habits, assumed a bold bearing, wore their caps on one ear, and strove to exhibit various little soldier-like gestures.

When the day of departure arrived, the conscript, at the summit of his ambition, and in the words of the popular songs of the times, "Impatient to fly to glory," was eager to escape from the sorrowful embraces of his family, and, imagining himself to be already in possession of a uniform, the helmet of a dragoon, or the fur cap of a grenadier, took a proud leave of his fellow-workmen. They, on their side, failed not to drink to the health and prosperity of the future hero. Many of them, particularly the younger ones, envied him his lot and his dress; and all, full of the warlike enthusiasm which was kept up by the glorious news received from the theatre of war, surrounded their brave comrade, and escorted him in triumph to the outskirts of the city.

These farewell scenes were of frequent occurrence, as is well known. They displayed, even to the last years of the empire, the same warmth, the same patriotic ardour, the same devotion, but more especially among the working classes, who had always been accustomed to consider the soldier's life as a sure road to honour and distinction.

It was strange to behold the changes effected by the air of the camp and the smell of gunpowder, in a few months, upon our young men so enamoured of the glory of war. New soldiers,—they did not require any length of time to accustom them to the soldier's duties. They advanced boldly upon the fire of cannon as if to some amusement. Having left home young conscripts, for a campaign, they returned thither veterans in experience. Numerous circumstances gave rise to the dis-

play of valour and of skill,—and this valour, this skill was generally found in those of obscure rank,—in those who had been mechanics. How many of our most intrepid officers, of the most able generals of that brilliant epoch began life as apprentices in the workshops of our suburbs!

The wars of that time mowed down a great number of men. But of what consequence was death to the heroic recruits of our cities and our provinces? To behold them marching gayly forward to the storming of a dangerous redoubt, or sustaining the shock of a powerful charge of cavalry, would not any one say that these men believed themselves invulnerable? When we hear the dramatic recital of the great imperial expeditions, when we figure to ourselves the columns of Austrians, of Prussians, and of Russians, broken down and destroyed almost instantaneously, when we learn that the most strongly fortified places yielded after a few days to the efforts of our arms, we are inclined to think that the French troops, so universally formidable, were composed of veterans grown gray in the service of their country. But this was by no means the case. They consisted only of the youth of our manufactories and work-shops; that ardent youth, intrepid, and often rash, and which three or four years before was playing at ball and top in the public squares. Now they were playing a much more interesting game, that of war. Before them arose the ladder of promotion, rousing and cherishing their noble emulation. The cross of honour and the epaulette, those rewards of merit and bravery, were the twofold ambition of our young troopers.

And when, after one of those rapid campaigns which opened the gates of Berlin and Vienna to us, the young soldier, profiting by a short truce, was able to return and pass a few days under the humble roof where he was born, how glorious it was to reappear amongst his family clothed in the insignia of command! How brilliant a family triumph! The young officer had the joy of receiving the congratulations of all his relations; he pressed them by turns to his heart, with an unrestrained outpouring of

tenderness, and responded to all their caresses. The affectionate sister testified in many ways her attachment; the little brother stood on tiptoe to touch the cross upon his breast; the good mother hastened to clasp him in her arms, whilst the venerable father, a respectable mechanic of former days, claimed his turn with a truly patriarchal simplicity.

Such home scenes recurred frequently, during Napoleon's reign, in the families of our mechanics. We would readily suffer ourselves to be led away by the pleasure of describing all their details, but space fails, and our subject recalls us.

CHAPTER XXXIX.

MAELZEL'S AUTOMATA.

LEONARD MAELZEL, a celebrated machinist, who merited the surname of the German Vaucanson, appeared at that time on the horizon of the arts. He was born at Ratisbon, in 1776. He came to Paris in 1808, where he excited general astonishment by his masterpieces of mechanism.

We have often been tempted to consider as fabulous, the numerous wonders cited by historians when speaking of certain artificial machines. But since we have beheld some of the automata of Vaucanson, and the speaking heads of Mical, we have less reluctance in expressing our credulity.

For instance, after the duck which eats and digests; after the flute-player which charms all listeners by its brilliant execution, it would be ungracious to call into question the figure constructed, it is said, by the celebrated Albert le Grand, which opened the door of this learned man's cell, and addressed several sounds to those who entered. The same remark may be made with respect to the iron fly made by John Muller, or Regiomontanus of Konigsberg. This fly flew round the room and returned to settle on the finger of its maker. Some historians mention a golden tree belonging to the Emperor Theophilus, which was filled with small birds, who produced a melody similar to that of nightingales. Finally, King Theodoric, writing to Boetius, a constructor of machines, speaks as follows:

"By means of your art, metals emit sounds, birds sing, ser-

pents hiss, and you can give to animals a harmony which they have not received from nature."

The descriptions of historians have no doubt exaggerated the merits claimed by these wonders of mechanism. But what we have witnessed in our day authorizes us to believe that these accounts are well worthy of confidence.

For example, the famous musical mechanism which Leonard Maelzel exhibited to the admiration of the Parisians in 1808.

This instrument received from its inventor the name of panharmonicon. It was moved solely by springs, and was found to imitate the sounds of all wind instruments with a precision and a perfection which art, in spite of the efforts of the greatest masters, had never before been able to attain.

The instruments of which the panharmonicon is composed, are the flute, (flauto picciolo,) the clarionet, the hautboy, the bassoon, the French horn, the trombone, the serpent, and the trumpet. We must add the kettle-drum, bass-drum, cymbals, triangle, and every other which is a part of musical artillery. The appellation panharmonicon, explains the nature and the functions of this piece of mechanism.

Méhul, Cherubini, Pleyel, and other celebrated masters, astonished at this prodigious creation, testified their high esteem for its author by offering him pieces of music of their own composition. The panharmonicon executed Haydn's Military Symphony, an Echo composed for it by Cherubini, a French march, and a series of German dances.

"It is hardly possible," says a writer, "for a company of musicians to perform military pieces with more precision, with the variations of *piano* and *forte* more exactly marked, and more truly certain. It was not merely an illusion; the true sounds of the instruments themselves were heard. The trumpet execution, especially, astonished a virtuoso, and could not be surpassed. The principal merit of this mechanism was, that the contriver had known how to provide for each instrument its proper em-

bouchure, and one which, at the same time, corresponded perfectly to the powers of the human organs."

Together with his panharmonicon, Maelzel exhibited a figure of human size and proportions, representing a trumpeter in the Archduke Albert of Saxe Teschen's regiment of Austrian cuirassiers.

This figure sounded all the cavalry manœuvres, and accompanied the piano.

Still later, this able mechanician rendered a great service to musical science by inventing the ingenious instrument to which the name of metronome has been given.

I will endeavour to give my readers an idea of the mechanism and the utility of this instrument. It is universally known that in order to indicate the different degrees of rapidity of movement in music, words borrowed from the Italian have long been in use; but as composers have not all made use of the same mark for the same movement, and as many have attached various significations to the same mark, the performer is necessarily liable to error, unless some arbitrary interpretation were affixed to these.

This inconvenience was a great one; Maelzel's metronome removed it completely. The principal part of this instrument is a pendulum, whose bob being moveable up and down on the rod, is thus capable of increasing or decreasing the length of a note or bar, as required by the character of the music. The length or duration of a note is often expressed at the head of a piece of music by stating that a pendulum of a given length in inches, will vibrate a minim, crotchet, or other note, as the case may be.

As soon as the metronome became generally known, that is to say, as soon as its merits had stood a short test, the most renowned Parisian composers, Berton, Boieldieu, Catel, Paer, Cherubini, Herold, and various others, appreciating the simplicity and the precision of the metronome, signed a resolution to make use of its system for marking the time of their music. The renown of this instrument soon spread over all Europe,

and Maelzel obtained patents, not only in France, but in England, Austria, and Bavaria.

At the Louvre exhibition in 1823, some extremely curious speaking figures were displayed, the work of the author of the metronome and the panharmonicon.

Such are Maelzel's claims to the great reputation his name has obtained. But, to speak the truth, if he had made nothing but automata, however ingenious and curious the mystery of their construction, he would be now almost forgotten. Even his panharmonicon, notwithstanding the eulogiums passed upon it by men of musical science, would not have been sufficient to perpetuate his name. Who, at the present day, remembers the name of Corneille Drebbel? Nevertheless, this man, of a most inventive genius, constructed a musical instrument which opened of itself at sunrise, and played of itself the whole day whilst the sun was in the sky; when the sun disappeared, its sounds died away, but could be renewed by the application of heat to the outer part of the instrument, in which case it would play again, as if in the sunshine. This was, in some sort, an imitation of the statue of Memnon, so celebrated in the ancient Greek mythology. I will add another example.

According to the accounts of several historians, when Henry III., brother of Charles IX., King of France, was elected King of Poland, and made his entrance into Cracovia, the Poles endeavoured to testify their joy by public festivals of all kinds. Among other marks of respect appeared one which was a masterpiece of mechanism. Wherever the king passed, he was followed, and we may say escorted by a white eagle, made with such art that it did not cease for one instant to fly around the young monarch, flapping its wings over his head. This was, undoubtedly, a most extraordinary machine; and yet who can tell, at the present day, the name of the man who conceived the idea, and put it so skilfully into practice?

This species of curious ingenuity is not alone sufficient to immortalize a man. But on the other hand, however simple a me-

chanism may be, if it is useful to mankind, it is sure to perpetuate the inventor's name, unless it originated in a barbarous age. Tradition has preserved the names of William Beuchels and John Rouvet, because the former first taught the art of salting and packing herrings, and the latter was the inventor of the art of floating wood.

History will never forget the modest Jacquard, who, by the invention of the machine which bears his name, has contributed greatly to the prosperity of an important branch of manufactures. In the same manner Maelzel will remain immortal through his metronome; even if musical science should ever be entirely overturned by one of those revolutions which sometimes take place in the regions influenced by the human mind, his name will always maintain a place in the annals of general science.

Oberkampf.

CHAPTER XL.

CALICOES, SILKS, AND OTHER TEXTILE FABRICS.

AT this period we meet with a founder of important manufactories, who, by the services he rendered to his country, demands our attention and the gratitude of all France. I speak of Oberkampf.

Born at Weissenbourg in 1738, Oberkampf served an apprenticeship to his father, in the manufacture of printed calicoes. The latter, an ingenious and industrious man, had established a manufacture at Aarau, in Switzerland, where he was naturalized in return for his energetic efforts in favour of his art. Under so skilful a master, the young man acquired much valuable information, which afterwards gained him both fortune and fame.

At that time, printed calicoes and chintzes only were known in France, and were sold at very high prices. A severe prohibition forbade their importation from other countries. The interests of the cultivation of hemp and flax, as well as that of

the preparation of silk, were the principal motives alleged against it. A man of a genius as persevering as that of Oberkampf was required to triumph over these obstacles.

Full of his project for founding a manufactory, Oberkampf set out for Paris with the moderate sum of six hundred francs, the fruits of his savings. He was then but nineteen. After many efforts and many solicitations, he obtained, in 1759, the permission to form an establishment, and set himself to work at once.

He remarked, in the neighbourhood of Versailles, a desert piece of ground, situated in the valley of Jouy. It was here that he laid the foundation of his manufactory of printed calicoes. An extensive marsh made this spot extremely unwholesome; but ingenious labour dried it, and rendered it an agreeable and salubrious residence. At first, Oberkampf, reduced to his own resources, lived alone in a small peasant's house, fulfilling, by turns, the functions of designer, calico printer, and painter. But his solitary residence was soon peopled in a surprising manner. He undertook the charge of pupils who assisted him in his labours. By degrees his establishment increased and prospered. Thousands of labourers and workmen crowded thither, bringing with them new resources, new talents; and, notwithstanding the persecutions and the difficulties to which Oberkampf was subject, he had the honour, by the exhibition of the products of his manufactories, of setting France free from the tribute paid to foreign countries.

From one year to another, the Jouy manufactory received important additions. Oberkampf had agents in England and Germany, and even in India and Persia, who procured him all the technical information relative to the secrets of his art, especially in dyeing. He succeeded in making window-blinds, at Jouy, of printed calico, coloured and designed after the manner of the old-fashioned church-windows, and which, by admitting the light, had a very beautiful effect.

Before the breaking out of the revolution, Oberkampf was in

the enjoyment of considerable renown. Louis XVI., in order to recompense him for having created so important a branch of industry, wished to ennoble him; but Oberkampf had the prudent modesty to refuse an honour which would make him the object of much envy. During the reign of terror, it was not without difficulty that he escaped from banishment and from death.

Oberkampf obtained the gold medal at the exhibition in 1806. The printed calicoes from Alsace took the second rank.

Napoleon, whose great mind embraced every thing which contributed to the prosperity of his empire, did not neglect the eminent merit of Oberkampf.

During a succession of visits made by him to the manufacturing towns of the west and north of France, surprised to behold himself every where surrounded by manufactories founded by Terneaux, the emperor exclaimed in admiration: "Why, Monsieur Terneaux, I find you and your works every where!"

When he visited the Jouy manufactory, he took the cross from his own breast and placed it upon that of Oberkampf. At a second visit he addressed to him the following extremely flattering words: "You, as the founder of Jouy, and I as emperor, carry on an animated war with England; you oppose them by your industry, I by arms; nevertheless, I must confess, your mode of battle is preferable to mine."

At that very time, Oberkampf was employed in seeking a means of imitating the English method of spinning and weaving cotton. This was the origin of the cotton spinning mill at Essone, the first ever established in France.

In 1790, the council general of the department of Oise, in consideration of Oberkampf's services, wished to erect a statue in honour of him; but he, with the same modesty which induced him to decline Louis XVI.'s offer, would not consent to it. Under the empire he also refused the dignity of senator, offered him by the chief dignitary of the country.

Oberkampf's last days were embittered by grief. This was

in 1815. His industry had much to suffer from the invasion of foreign troops. He sighed at the view of the picturesque walks in the neighbourhood of his manufactory, which now presented the mournful silence of poverty and despair, instead of the life and activity which he had formerly by his own example introduced in this well-loved spot. His workshops were closed; the workmen with whom they had for sixty-one years been filled, asked for work and for bread.—"This spectacle kills me," said the venerable Oberkampf, and he died in fact, in the month of October, 1815.

The branch of industry which owe its origin to Oberkampf has spread over all France with rare prosperity. Numerous establishments have been formed upon the plan of that at Jouy. The workmen employed in them are estimated at from two to three hundred thousand. From a raw material of the value of 60,000,000 francs, France gains a profit of 240,000,000. At present the richest and most beautiful designs are printed on cotton; three or four colours are combined, presenting a beautifully shaded appearance. The exportation of printed calicoes has been an important part of French commerce. This material is used for bed and window-curtains, coverings for divans, sofas, arm-chairs, &c. At the present day the value of the printed cottons exported by us, exceeds 53,000,000 francs. And all owing to Oberkampf.

In imitation of Oberkampf and of Terneaux, other manufacturers instituted new arts, or originated important improvements.

In 1806, the manufactories of Saint Quentin and Tarare obtained gold medals for the excellence of their muslins. Their success was an extremely remarkable manufacturing triumph, for it is well known that this branch of trade presents great difficulties in the weaving of cotton.

The town of Lyons, so long under the axe and the fire of a revolutionary government, had resumed her rank among the manufacturing cities of France; and, thanks to the protection

and encouragement afforded by Napoleon, her days of prosperity came back to her.

At the exhibition in 1806, the richness and beauty of the Lyons silks were much admired, especially in velvets and satins.

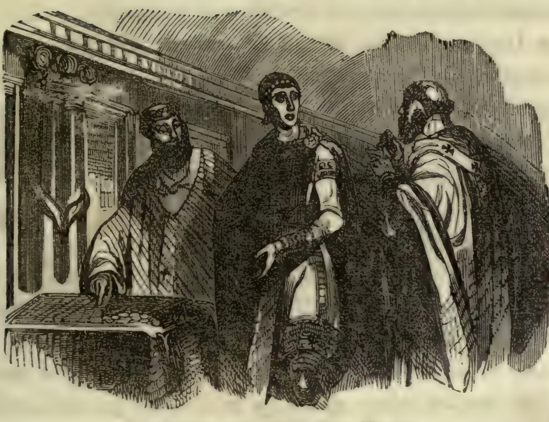
What marvellous improvements have been made in the preparation of silk and the art of weaving it, since its introduction into France from the country of Seres?

It was not until the seventeenth century of the Christian era, that this event, so remarkable in the annals of history, took place; previously the true nature of silk was not understood in European countries. The Romans, masters of the universe, were long in ignorance of the uses to which it might be applied; so that among them silk was sold for its weight in gold.

In the introduction to his *Universal Dictionary of Commercial Geography*, the conscientious Peuchet gives an interesting account of the curious circumstances attendant upon the origin of the cultivation of silk in Europe.

"The Emperor Justinian," says he, "desiring to free the commerce of his subjects from the exactions of the Persians, endeavoured, by the aid of his ally the Christian King of Abyssinia, to take from the Persians a part of the silk trade. He was unsuccessful in this attempt, but a sudden and unexpected event placed within his reach, to a certain degree, the object he had laboured to attain.

"Two Persian monks having been employed as missionaries in some of the Christian churches, which, according to Cosmas, were established in different parts of India, had opened a road for themselves into the country of Seres, or China. There they observed the silk-worm's labours, and made themselves acquainted with all the processes by which this fine thread is converted into so great a variety of beautiful stuffs, attracting general admiration. The hope of future gain, or perhaps a holy indignation at beholding infidel nations in the sole possession of so lucrative a branch of commerce, induced them to return immediately to Constantinople.



Justinian and the Persian Monks.

"There they explained to the emperor the origin of silk, and the various modes of manufacturing and preparing it. Encouraged by his liberal promises, they undertook to bring thither a sufficient number of those industrious little creatures, to whose efforts man owes so much. Consequently, they filled hollowed cane-stalks with silk-worms' eggs; hatched them in the warmth of a dunghill; fed them on the leaves of the wild mulberry, and the worms multiplied and worked in the same manner as in the hot climates where they first attracted the attention of man."

A great number were soon naturalized in different parts of the Grecian empire, and especially in the Peloponnesus. Afterwards (in 1130), Sicily undertook, and with great success, the breeding of silk-worms, and the example was followed in various towns throughout Italy. Manufactories of considerable extent were established in all these places, and the new production made up into different stuffs. The same great quantity of silk was no longer brought from the East; the subjects of the Greek emperors were no longer obliged to have recourse to the Persians

for this article, and great changes took place in the nature of the commercial relations of Europe and India.

From Italy and Spain, the manufacture of silk passed into the southern provinces of France. In 1470, silk manufactories were established in Tours, by Louis X.; but the workmen here employed came from Italy, and even from Greece. Henry IV., in his turn, established a silk manufactory in the Chateau of the Tuileries, and in that of Madrid, near Paris. This prince was also the founder of the first silk manufactories at Lyons. He entered into an arrangement with those who undertook the direction of the establishment, by which they were to go annually into Spain in search of silk-worms' eggs.

In order to accelerate the progress of this branch of industry, Henry IV. caused white mulberry trees to be planted, and silk-worm nurseries to be established in the neighbourhood of Lyons.

Still later, towards the middle of the seventeenth century, Octavio Ney, a merchant of Lyons, discovered the secret of giving a lustre to silk. Towards 1717, Jurines, a dealer in ornamental articles, of the same place, invented a very convenient machine for the fabrication of silk stuffs; and at the same time, an ingenious mechanism was brought into use by a manufacturer of the name of Falcon, the object of which was to facilitate the labour of the workmen employed.

In consequence of the powerful impulse given by Napoleon, other improvements and other inventions were successively introduced into this branch of manufactures.

In 1806, Gensoul, of Lyons, received the highest reward at the exhibition for the invention of a process for heating by steam the water contained in the vessels in which the cocoons are placed to be wound. This process is not only economical as regards fuel, but also contributes much to the beauty of the silk.

At the same exhibition, Dagaz, and Saint Chamond, manufacturers, obtained the gold medal for their plain and figured ribands of satin, velvet, &c.; and, besides this honour, received the following commendation from the committee appointed to

judge of the articles exhibited: "These ribands seem to have been made for the purpose of putting to shame those which England has hitherto produced."

At the same time, the manufacturer Bonnard acquired an indisputable superiority over other manufacturers in the fabrication of crape and silk tulle. Nothing can surpass the beauty of his tulle, which is of a double net, and is not injured by washing.

Among the silk stuffs displayed to view at this exhibition, were some with raised figures of gold and silver, which equalled the finest embroidery.

Let us also mention the efforts of Bontems, a Parisian, who imitated the Madras handkerchiefs, which were a mixture of silk and cotton; those of Leblanc Paroissien, of Rouen, who, by the aid of a simple contrivance, succeeded in rendering the process of shearing cloth more rapid, easy, and regular. At Louviers, Marzeline napped cloth by a useful mechanism consisting of a continued rotation. Pouchet, the ingenious Rouen manufacturer, twice received the gold medal for improvements in carding, winding, and weaving cotton.

Whilst our manufacturers, stimulated by Napoleon's encouragement, daily increased the revenue of the country, our victorious armies made their power known to all the united nations of Europe. During this remarkable reign of ten years, styled the empire, the French grenadier, with his knapsack on his back, was to be met with in all parts of Europe. He might be mistaken for another Ahasuerus, but with this difference, that every step of his route was marked by a victory, and that he made all people respect the imperial eagle, from the Tiber to the Danube, from the Ebro to the Volga.

Under the pleasant shade of these triumphs, the French manufactories bloomed and prospered. "All Europe," says M. Charles Dupin, "accepts, either from inclination or compulsion, the prohibition to make use of English manufactures. England

declares a continental blockade against all Europe. One single potentate, the Emperor of Russia, refused to agree to this prohibition; thence arose a pretext for a war, in which the elements struggled against us, and Napoleon's army, victorious over all the rest of Europe, was destroyed by cold and famine."

James Watt.

CHAPTER XLI.

THE STEAM ENGINE—SAFETY LAMP—STANHOPE PRINTING-PRESS.

IN speaking of the scientific part of manufactures, equity commands us to put aside all that narrow spirit of nationality which raises a barrier between one people and another. Science should be cosmopolite; its conquests are, so to speak, common property. Every one enjoys them, and the men who spend their lives in labouring for the welfare of their fellow-beings, who consecrate their genius, their hours of study, their whole existence, to useful inventions,—these men, I say, have strong claims upon the respect and gratitude of the whole world.

Who, for example, would blame us for placing in our gallery of illustrious mechanics, the Scotchman, James Watt, or Humphrey Davy, the Englishman? Are not some names as popular in our continental countries as in Great Britain? Assuredly;

and it would be most silly to omit them in a work such as ours; for, if this were done, it might, without hyperbole, be said, that these celebrated names were actually noticed in the omission itself.

The Institute of France professed the same opinions with regard to this subject; and proved them, in 1808, by calling James Watt to a place among its eight foreign members.

James Watt, born in 1736, at Greenock, in Scotland, was at first a simple workman in the establishment of a mathematical instrument maker in London. His weak health obliging him to return to his native country, he fixed himself at Glasgow, and at the age of twenty obtained the title of philosophical instrument maker in the university of that city.

But James Watt's merits did not end here. From a skilful workman, he rose to the rank of an engineer of the first order. Important canal improvements spread his reputation throughout England. At last a discovery of the highest importance procured him an imperishable fame as a mechanician.

James Watt happened to be intrusted with the repairing of a model of a steam engine, constructed upon Newcomen's plan, and destined for the instruction of the students at Oxford. This circumstance gave him an opportunity of examining the defects in this machine and the means of remedying them, and inventing improvements.

In Newcomen's plan there was a great loss of heat, consequent upon the injection of cold water, for the purpose of condensing the vapour. Watt invented a plan for completely condensing the vapour in Newcomen's atmospheric engine, without cooling the cylinder. This was effected by means of a condenser detached from the cylinder. Other fortunate efforts followed. He added a pump, put in motion by the engine itself, and which draws off the hot water and air from the condenser.

To give an idea of the importance of the successive improvements made by Watt in Newcomen's atmospheric machine, it

will be sufficient to state that the economy in fuel was valued at sixty per cent.

Notwithstanding these advantages, it is to be presumed that Watt's discoveries would have remained buried in the obscurity of his workshop, if it had not been for the well-directed and generous assistance of Matthew Bolton, one of the first of the Birmingham manufacturers. Watt, of a reserved disposition, mixing but little with the world, and carrying his modesty to a degree of timidity and shyness rarely to be met with, was not capable of turning his discoveries and inventions to advantage. Matthew Bolton, understanding the whole force of the young man's genius, obtained accurate information of the extent of his labours as a mechanician, and placed the whole of his fortune at Watt's disposal.

Bolton had expended, in the establishment of workshops and foundries, as much as 1,250,000 francs, from which he had not yet received any return. Soon after, in order to assure full success to Watt's machines, he offered to provide them gratuitously to all those who wished for them, and to keep them in repair at his own expense; asking, as sole indemnity, one-third of the money saved in fuel by the new engine.

Such liberal conditions brought the engine into use for working mines, and the profits which accrued to Bolton and Watt were very great.

Encouraged by this success, Watt continued his researches with a zeal truly worthy of his extraordinary genius. What he sought now was the application of steam to manufactures of all kinds; and he laboured hard to construct an engine, by means of which the power of steam could be applied to any mechanism whatsoever.

In this manner he succeeded in the completion of the true steam engine, and placed in the hands of mankind a continual, uniform, and constant power, infinitely divisible, and equally susceptible of increase as well as of general application.

James Watt, although he received neither instruction nor for-

tune from his parents, became, by his own efforts, one of the best-informed men in England. In continuing and bringing to perfection the attempts of Solomon de Caus, Papin, and Newcomen, he gained a victory over the title of inventor by placing the power of steam under man's authority. He died, in 1819, at the age of eighty-four.

Humphrey Davy, if he had invented nothing but the safety-lamp, that discovery so useful to the miner, would, for that alone, merit the eternal gratitude of the true friends of humanity.

It is well known, that in coal mines an inflammable gas is frequently generated, which, unfortunately for the miners, when mixed with atmospheric air is liable to take fire from the flame of a lamp, and to explode with great violence, mutilating and wounding all those who happen to be present, and destroying whatever opposes its passage, however solid it may be.

It was a desire to put an end to such disastrous accidents, which suggested to Davy the fortunate idea of the safety-lamp.

With this view he visited the mines. After ascertaining that the carburetted hydrogen, of which the inflammable gas is composed, would not explode if mixed with less than six and more than fourteen times its own volume of atmospheric air, he discovered, besides, that explosive mixtures cannot be inflamed through minute apertures in metallic surfaces or tissues; and finally, that a mixture of air and carburetted hydrogen, in proportions otherwise explosive, would not explode if confined in a tube of small diameter, and proportionate length.

In consequence of these observations, Davy constructed a lamp, the flame of which was wholly enclosed in a cylinder of fine wire gauze. Experience has proved that this cylinder, this metallic cage is impenetrable to a current of inflammable gas; the latter will burn on the inside of it, around the flame of the lamp, and at last extinguish it, but will not burn on the outside of the wire gauze.

Chance had no part in this important discovery; it was a pro-

The Safety-Lamp.

found acquaintance with the propagation and distribution of heat alone which rendered this valuable service to humanity.

"This lamp, more marvellous than the magical one of Aladdin," says an author, "has saved the lives of thousands of miners. The illustrious inventor shed additional glory upon his discovery; he might have made it a means of great profit to himself; but sacrificing all selfish feelings to an anxious desire for the well-being of the human race, he abandoned all such ideas."

Humphrey Davy began his life very much as did James Watt. Like him he had known poverty; like him, also, he knew how to repair the wrongs of fortune by his own efforts. A short time after the death of his father, who left a widow and five children in narrow circumstances, Humphrey Davy, who was the eldest, was apprenticed to an apothecary in Penzance, his native village, in Cornwall. But, endowed with an original, independent, and somewhat eccentric mind, the apprentice studied after a fashion of his own; so that, after some time, the apothecary, who was incapable of understanding him, was glad *to get rid of the troublesome fellow.*

Nevertheless, this *troublesome fellow* had, at that early period of his life, made great advances in scientific studies. Unable as he was to purchase any instruments, he supplied their place by whatever fell within his reach. Broken pipes and glass tubes were his apparatus. He made a pneumatic machine out of a syringe. With such a laboratory he proceeded to the analysis of the gas contained in certain aquatic plants called *fucus*.

Nevertheless, the young Humphrey only met with discouragement from the beginning of his career as a chemist. His nascent genius was disdained, misunderstood, and rudely checked. Such a mind as he possessed was required to triumph over so many disadvantages, and to gather new strength from every shock.

The following anecdote is related by M. Ferry, in his Encyclopedia, under the article *Davy*:—

A chemist of renown, son of the illustrious Watt, came to spend some time with the mother of Humphrey Davy. This timid young man was extremely ambitious of the honour of conversing with so learned a guest; but he must first fit himself for a conversation on the subject of chemistry. Lavoisier's treatise, translated into English, fell in his way. In two days he studied the whole work, commented upon it, and entertained some still newer views. The youth who hardly knew how to prepare an opiate, presented himself as a bold innovator in a science then considered susceptible of but few ulterior improvements. The discussion was animated; Mr. Watt, however, did not comprehend the remarkable talents of a man, who at the age of eighteen, without the advantages of instruction, had gained so great an amount of knowledge, and was able to communicate it with so much clearness. Humphrey did not, therefore, find in his mother's guest a Mæcenas disposed to assist the soarings of his genius; but having received a new impulse, he did not long remain in obscurity.

This *troublesome fellow*, as the apothecary of Penzance had designated him, became a professor of great distinction. The

Royal Society of London admitted him among its members. The Institute of France decreed him a prize, notwithstanding the war between the French and English governments. The Prince Regent knighted him, and subsequently elevated him to the rank of a baronet.

Finally, when this illustrious man died, in 1829, he had had the honour of succeeding the celebrated Sir Joseph Banks, in the presidency of the Royal Society of London.

Sir Humphrey Davy contributed greatly to the advancement of science. His discoveries in the properties of chlorine, and in the decomposition of earths by galvansim, have wrought great changes in the science of chemistry,—changes which may be called revolutions of a most astonishing nature. His researches into the effects of the respiration of various gases gave rise to new and important truths. Unfortunately, they were fatal to the author of them; for there is reason to think that his various experiments of this kind injured his naturally delicate constitution, and hastened his premature death.

Before we return to the national illustrations of our subject, let us do homage to another learned and ingenious Englishman, who deserves honourable mention in this book devoted to the efforts, the improvements, and the inventions, with which his career was filled.

Charles, Earl Stanhope, one of the most distinguished members of the British House of Lords, was also one of the most active and enterprising spirits of his age. At the age of eighteen, he gained a prize from the Society of Arts and Sciences in Sweden for his pendulum. The phenomena of lightning, and the means of averting their dangerous effects, were long the objects of his researches and experiments. He occupied himself also with improving *arithmetical machines*, the inventions of various men of genius. The result of his labours was a truly admirable invention.

"One of these machines, which is of the size of an octavo volume," says a biographer, "serves to perform with perfect accu-

racy the most complicated operations of addition and subtraction By aid of the other, which is nearly of the size of a writing-table, one may easily resolve the difficulties of multiplication and division. If it happens that the operator fails in attention, and makes a mistake, a spring, which sets a little ball of ivory in motion, points out to him his error."

Earl Stanhope is the inventor of the printing-press which bears his name, and which has effected a revolution in the art of typography. This last invention, which dates from 1815, occurred only a short time before the death of the inventor, which took place on the 13th of September, in the year following.

It was not until 1820, that the iron printing-press, invented by him, was brought from England to France. Several skilful mechanicians immediately imitated it. M. Bresson's Stanhope press was remarked; but has been but seldom reproduced. Those of this kind which have been improved upon by MM. Thonnelier and Gavaux, are held in high estimation.

To Earl Stanhope are also due various improvements in the construction of several musical instruments; a new method of covering houses with a composition of pitch, sand, and chalk, which has perhaps led to the asphaltum and bitumen of the present day; and a new mode of burning lime, by which the cement produced is much harder than ordinary cement.

Gaspard Monge.

CHAPTER XLII.

MONGE, THE GEOMETRICIAN.

IT is impossible to make mention of the progress of mathematical science under the empire, without letting fall a portion of praise and some laurels upon the memory of a man who did much in its service.

This was Gaspard Monge, the illustrious son of a little hawker of Beaune, who, in spite of numerous obstacles, became one of our greatest geometricians; obtained the honours due to genius, and maintained throughout his elevation, a candour, and a generosity, which did him no less honour than his active labours.

This man, born to give a new impulse to mathematical sciences,

was at first placed at the royal school of Mézières, among draughtsmen and stone-hewers, an humble station which Madame Roland disdainfully ranked with that of a mason, some years afterwards.

But the mason was destined to instruct the whole learned world.

The genius of Monge came to light of itself. The learned Nollet, well known for his *Philosophical Researches*, and the celebrated Bossut, then professor of mathematics, were anxious to have the modest stone-hewer as an assistant professor. The young man soon became a professor in reality, and began his glorious career by the discovery of the elements of water, like Lavoisier, Cavendish, and Laplace, of whose labours he was entirely ignorant. Called to Paris, his genius appeared to develope still more rapidly in that large sphere; the Academy of Sciences opened its doors to him (1780); three years afterwards he succeded Bezout in the professorship of instructor of the navy pupils.

At the beginning of the revolution, Monge, invested almost in spite of himself with the functions of minister of war, brought his vast fund of information into the service of his country, and displayed an active and energetic care for her interests, the happy effects of which were felt in every port of France.

Compelled by the power of party intrigue to resign his ministerial station, Monge still continued to be useful to his country. A formidable coalition menaced the frontiers of France; but cannon, saltpetre, and powder, were wanting for our defence. Monge proved what science is able to perform when applied to the wants of man. He discovered a new process for refining saltpetre; he substituted a moulding of sand for that of earth in the casting of cannons; he invented a more expeditious method of perforation than the one in general use, and instructed a large number of pupils in the art of making cannons.

After the revolution, or at least after its greatest violence

was past, Monge was placed at the head of the institution created under the name of *normal school*; he composed his immortal work on *Statics*; he took an active part in the foundation of the polytechnic school, of which he was one of the most illustrious professors; he accompanied the expedition to Egypt as a man of learning, as well as in the capacity of an officer, and upon his return, took his place again at the head of his beloved pupils.

The title of Count of Peluze, an ancient city whose ruins he had explored in Africa, the senatorship of Liege, the cross of the Legion of Honour, and that of the order of the Reunion, were the rewards heaped by Napoleon upon the head of his old friend; and great as they were, they seemed to fall far short of the long and brilliant services rendered by the modest Monge to his country. But he set no great value upon dignities. He remained the same simple-hearted man, the same amiable, generous man in prosperity as he was in his obscure youth, maintaining the same fondness for study and improvement which actuated his early years. He died in July, 1818, and France and science mourned his loss.

Monge, in giving rise to the art of descriptive geometry, has shed a strong light upon the subject of building, from the military fortification to the humblest dwelling-house. He knew how to bring science down to the level of application to general every-day matters. His treatise entitled *Stereotomy*, is truly worthy of him: a treatise on the art of cutting through solid bodies.

I will conclude this imperfect sketch with one of the numerous features in the life of Monge, which betrays in its fullest developement the beauty and delicacy of his soul.

Monge had just taken possession of Bezout's professorship. Marshal Castries, at that time minister, expressed a wish that the new professor should revise the elementary course of mathematics left by his predecessor; Monge resolutely refused to do

this, alleging as a reason, that Bezout's works were the only inheritance of his widow, and that he was unwilling to deprive the wife of a man who had done so much for science and his country, of any thing which might be of profit to her. Admirable disinterestedness, rarely imitated in this age of vile egotism and rapacious cupidity!

CHAPTER XLIII.

GOLD AND SILVER.

NAPOLEON'S reign was an epoch of the renewal of the goldsmith's art; that art which, by the richness of its work, is so appropriate to the pomp of religious ceremonies, and to ornaments for handsome apartments, as well as table-services.

The gold and silversmith's art has been known to a greater or less degree among all nations who have been accustomed to luxury and opulence. From the most remote antiquity, gold and silver were used for vessels, as the accounts in the Bible, and the descriptions given by Homer, Virgil, and other poets of antiquity, testify.

According to Goguet, Achilles' shield, as described by Homer, renders it certain that, at the time of the Trojan war, this art had reached no very great degree of perfection in Asia. The Scriptures speak of an artist called Bezaleel, who, by the aid of great talents in that line, constructed all the ornaments in the Temple at Jerusalem.

Among the artists of this kind who were distinguished at Rome, history has preserved the name of Praxiteles, a contemporary of Pompey, whom, however, we must not confound with the Athenian sculptor of that name. The lower empire had also its artificers in gold and silver; but bad taste had begun tc invade the dominion of the arts, and the graceful and natural designs of the ancients were succeeded by others, entirely wanting in both those qualities.

In the middle ages, the piety of the faithful contributed much to the progress of this art. What could be more beautiful than the work displayed in the shrines, the reliquaries, the vases and

other church ornaments in use in the different centuries of that religious epoch! "In studying the arts and the industry of the middle ages," says M. Capefigue, "what masterpieces of beauty do we not meet with! What finish in carving and shaping! Who, in the present day, among gold and silversmiths, could vie with Saint Eloi of antiquity, an account of whom has been handed down to us by a legend?"

This Saint Eloi, now read of only in old songs, was distinguished in the seventh century by a rare skill in the art of working in gold and silver. King Clotaire II., having commanded him to construct a seat or throne of royal magnificence, sent the young workman the quantity of gold deemed sufficient for the execution of his charge. But Eloi, with the material provided him, made, instead of one throne, two of exactly similar appearance, equally well made, and equally magnificent. The artist could in no better manner have proved not only his skill, but also his scrupulous honesty. This act made his fortune. He was made public treasurer; distinguished himself in several negotiations intrusted to him; became a priest, and was elected Bishop of Noyon. After his death, which took place on the first of December, 659, he was canonized in remembrance of his virtues and his benefits.

In a manuscript edition of this saint's prayers, the pious bishop is represented standing, in his cope and mitre, holding in one hand the episcopal cross, and with the other blessing the fire kindled in his workshop. An anvil is in front of his furnace, and on it a compass and a hammer; a simple homage to the dignity of the useful arts.

The annals of the middle ages are very sparing of the names of the pious artists who consecrated their leisure hours to ornamenting churches. It is with great difficulty that in the eighth and ninth centuries we discover those of Sens, Bernelin, and Bernuin, who, by their united efforts, constructed a table of gold, enriched with precious stones and inscriptions.

Under the reign of Philip the Bold, at the end of the thirteenth

century, a goldsmith named Raoul, renowned for his talents in this line, was ennobled. This was the first instance of honour conferred on one belonging to the working classes, which ever took place in France.

In the year 1330, the goldsmith's art was particularly noticed by Philip of Valois, who instituted laws governing it, and gave to it a coat of arms, consisting of a notched cross on a field gules, accompanied by two crowns, and two cups of gold, surmounted by the French standard.

Afterwards, King John permitted the body of goldsmiths to build a chapel, under the name and invocation of Saint Eloi.

Under Francis I. appeared the Florentine, Benvenuto Cellini, an artist of the first order, who gave his art a brilliancy it had never before possessed, and which has never been since surpassed.

Francis I. evinced a great admiration for the talents of Benvenuto Cellini, and loaded him with benefits. But this artist was unreasonably proud. He could not endure the disdain and the insolent treatment of the Duchess d'Etampes, who was all powerful at the court; and leaving France, where he had lived at his ease, he retired to his native village, and died there in poverty, in 1570.

Benvenuto, in his memoirs, relates the circumstance which induced him to leave France. He had executed a small silver vase, of exquisite workmanship, which he designed as a present for the Duchess d'Etampes, and which he set out to convey to her, in the idea that she was offended, because in a visit paid by the king and herself to his residence, at Nesle, his majesty had admired the various models prepared for ornamenting Fontainebleau, when the lady had differed from him in opinion.

"I took the pretty little vase," says Benvenuto, "which I had made for her, thinking to regain her good graces, and carried it myself. I spoke to one of her women, to whom I showed the present. . . . This person loaded me with compliments, and said she would go immediately and speak to her mistress, who was not yet dressed. She went to Madame, who replied, an-

grily, '*Tell him to wait.*' I overheard her say this; I armed myself with patience—a very difficult thing to me—and I waited, without growing angry, until she had dined. As it began to grow late, hunger put me in a passion which I could not resist at all. I cursed her a thousand times in my heart, and then took my leave. I went to see Cardinal Lorraine, to whom I presented the vase, only entreating him not to injure me with the king.

"The cardinal replied that such a request was entirely unnecessary, but that he would remember to speak favourably of me whenever the occasion should present itself; then he called his treasurer and whispered in his ear. The latter waited until I had taken leave of the cardinal, when he said to me: '*Come with me, I will give you a glass of wine.*'"

The animosity of the Duchess d'Etampes pursued Benvenuto Cellini unceasingly. The haughty favourite said to herself frequently, "How is this! I govern the world, and a mere nobody like Cellini pays me no respect!" Francis I. gave the artist possession of the domain of the Chateau de Nesle; the duchess persuaded the king to instal in one of the out-buildings a distiller who had made her a present of some scented waters, considered efficacious in beautifying the complexion. Cellini violently opposed this invasion; he complained of it to the king, who laughed at him, and signed a paper giving him unreserved possession of the chateau. At last, the duchess, determined to injure Cellini, endeavoured to represent him to the king as an enemy of the holy rosary, a heavy crime in those days.

Benvenuto Cellini executed some very large works in France, namely, the plan for a fountain, in which the principal figure, representing Francis I. as Mars, was fifty-four feet high; the silver figure of Jupiter, estimated at a thousand gold crowns; the ornaments on the gate at Fontainbleau, and various others.

Of all his performances, there remains now in France only the bronze figure of a nymph in bas-relief, to be seen in the Museum of the Louvre.

As to his vases, salt-cellars, and other small articles of gold made by him, the revolution dispersed them. Nevertheless, a golden salt-cellar representing the *earth* and the *ocean,* is said to be existing at the present day, in the Belvidere at Vienna, as well as the *four divisions of the day*, made by this great artist for Francis I., and presented by Charles X. to the Archduke Ferdinand of Austria.

There have been few modern artists who have equalled Cellini in renown. He is considered as the perpetual type of an artist *par excellence.* M. du Sommerard, a competent judge, says of him: "The colossal Benvenuto Cellini is as perfect in the execution of his gigantic bronze figures as in the microscopic details of the clasp on the cope of Clement VII." This clasp of sculptured gold is ornamented with precious stones, and carved in bas-relief and fret-work.

The reign of Louis XIV., so fertile in every species of talent, had many distinguished artists in this line.

John Varin, an engraver and goldsmith, a native of Liege, died at Paris in 1672. He directed the stamping of medals and counters.

Claude Ballin, who succeeded him in this occupation, won by his skill the admiration of Cardinal Richelieu, and afterwards of Louis XIV. It was by copying Poussin's pictures that he improved his taste for drawing. At the age of nineteen, he executed four large silver vessels, upon which the four ages of the world were represented with admirable precision. Cardinal Richelieu, struck with admiration at these masterpieces of sculpture, purchased them and ordered four antique vases as accompaniments to them.

Ballin made silver tables for Louis XIV., stands, candelabra, vases, and various other articles. The first golden sword, and the first gorget worn by this monarch, were the work of Ballin. His bas-reliefs representing Pharoah's dreams were much esteemed.

All Ballin's performances were distinguished by their infinite

beauty and delicacy. Unfortunately for the art and the artist, Louis XIV. was obliged to part with all these gorgeous articles in order to defray the expenses of the long and disastrous war of the succession. The revolution afterwards destroyed the few remaining memorials of this artist, existing at Paris, Saint Denis, and Pontoise.

The art of working in gold and silver has nothing in common with the generality of mechanical arts, in which habit and experience are sufficient to gain a man a species of excellence, and acquire him renown.

To excel in it requires a distinct talent, as do painting, statuary, and architecture. It requires a knowledge of modelling and of drawing. The artificer in gold and silver who aspires to the dignity of an artist, who feels a longing to eclipse all rivals, must understand the principles of perspective and of architecture, in order to give his compositions the true proportions; to be able to distinguish accurately between the fitness of one form and another, and to avoid a superfluous use of ornament. He must be able to decorate them agreeably, and present to the eye of observers an exact imitation of nature and geometrical forms.

But, in consequence of the valuable nature of his materials, the artificer in gold and silver must naturally be oppressed with anxiety and discouraging anticipations; for, as the beautiful creations of his hands increase in size and beauty under his skilful efforts, his prophetic spirit beholds them after a course of years melted down to shapeless masses of metal, by the avaricious cupidity of the possessors.

In this respect, Claude Ballin received more honour than Benvenuto Cellini. If his works, in which he united modern graces to antique beauty, were sacrificed to the necessities of the country, they did not entirely disappear. Launay, Ballin's nephew by marriage, an excellent goldsmith and skilful designer, made sketches of all his uncle's works before their destruction.

After Ballin, we must mention Pierre Germain, a skilful

sculptor and royal goldsmith, who died in 1682, at the age of thirty-five; he excelled in designing and carving.

Colbert, the minister, who appreciated and encouraged his talents, intrusted to him the charge of sculpturing the allegorical designs on the golden plates destined as a cover to the collection containing the conquests of Louis XIV. All connoisseurs admired this valuable piece of work, for which Pierre Germain obtained a magnificent reward.

This artist, cut down in the flower of his age, has left behind him medals and counters, upon which are represented the most memorable events in the illustrious reign of Louis XIV.

Pierre Germain's great reputation was sustained with equal splendour by his son, Thomas Germain, who, during a long sojourn in Italy, made great improvements in designing and working in gold and silver.

Numbers of his masterpieces remained in Italy to enrich the palace at Florence, when he returned to Paris. From that time he received commissions from every court in Europe. Louis XV. was so delighted with the execution of a sun which was presented to the cathedral at Rheims, on the day of his coronation, that he offered the artist apartments in the gallery of the Louvre.

All those interested in this beautiful art agree in pronouncing the works of this artist to be replete with demonstrations of genius and good taste.

Thomas Germain was elected sheriff (échevin) of Paris in 1738; he died on the 14th of August, 1748. A magnificent church was erected at Leghorn upon a plan of his, as well as that of Saint Louis at Paris.

The seventeenth and eighteenth centuries produced several other distinguished artists of this kind, among whom were John Bourquet, Bricau, Pierre Barrié, John Bernhidi, Du Caurroy, and Aurelle Meissonnier, who died at Paris in 1750; this last was a painter, architect, sculptor, and worker in precious metals.

At the time of the establishment of the consulate, there re-

mained in France very few vestiges of the labour of the workmen we have mentioned. These had either been taken to other countries by emigrants, or melted in the crucibles of the reign of terror. The new government gave new life to this art, so indispensable to the majesty of courts.

It reappeared with the magnificence which distinguished it in preceding ages. A beautiful service, executed by a jeweller named Augustus, attracted much attention at the ceremony of Napoleon's coronation.

John Baptist Claude Odiot, the same who, on the 30th of March, 1814, defended Paris with so much valour at the head of the second division of the National Guards, the same whom Horace Vernet has immortalized in his splendid painting of the battle of Clichy, appeared, under the empire, the worthy successor of Ballin, Launay, and the two Germains. His labours soon spread his reputation over all Europe. At all the exhibitions of the products of French industry, he constantly obtained the prize of the first order. He executed numerous table-services, as remarkable for the exquisiteness of their finish as for the beauty of their forms.

Amongst M. Odiot's celebrated performances, which raised him to the rank of one of the first in his profession, at the present day, we must not omit to mention the magnificent toilet-table, and complete apparatus belonging to it, valued at 8,000,000 francs, presented by the city of Paris to the Empress Maria Louisa, in 1810; the cradle of the King of Rome, also presented by the city of Paris, in 1811; the table-service for the Polish Princess Braniska, valued at 3,000,000 francs; a breakfast-set of most beautiful execution, presented to the Duchess of Berri at the birth of the Duke of Bordeaux; an ink-stand representing Apollo and the nine Muses, which Louis XVIII. sent to Pope Pius VIII., and which was the admiration of all Roman artists; a virgin of silver, for Notre Dame at Paris; a silver statue of Henry IV. as a child, after Bosio; and

Odiot.

finally, a magnificent table-service valued at 800,000 francs, for Ferdinand I., King of Naples.

The Baron Charles Dupin speaks in the highest terms of Odiot, senior. "His performances," remarks he, "are beautiful reproductions of the antique vases, and are not less remarkable for the wise and skilful adjustment of forms and figures. This art, perfect in proportion to the concealment of the junctures, unites elegance to solidity, to a degree which renders it of royal value."

"The artist of whom we speak," adds M. Dupin, "entertained the fortunate idea of executing bronze models of his most remarkable works. He presented this collection to the Museum of the *Chambre des Pairs*. If Benvenuto Cellini had had the same foresight, and the same generosity for Rome or for Florence, his country and the Medici Museum might have pre-

served the much to be regretted masterpieces, of which we have now but meagre descriptions."

With the exception of the Cross of Honour, which he so well deserved, and which Louis XVIII. placed upon his breast in 1814, M. Odiot, senior, received from the government none of the honourable distinctions so often conferred upon unworthy favourites. But, with merit such as his, there were many consolations for a like exclusion. His fame as an artist, and the gold medals decreed to him as testimonials of profound admiration, were infinitely preferable to court favours.

CHAPTER XLIV.

SEVRES CHINA, &c.

AT the commencement of our work, we made a casual mention of the royal porcelain manufactory at Sevres. We will now return to this subject, and give an account of various important improvements.

"It was at Sevres," says M. Capefigue, "that Colbert established a vast manufactory, where antique vases were modelled, and Chinese and German urns imitated; the best paintings copied, hunting-scenes, battles, and natural flowers of brilliant colours. Fifty workmen were convoked from various parts of Europe; everything was reduced to rules, and experiments tried upon the earth and water used. The Sevres china acquired a great reputation over all Europe; the king sent presents of it to every court; and it became a gracious offering at the conclusion of a treaty. The Sevres manufactory was a subject of pride to Louis XIV."

Napoleon betrayed no less solicitude for the prosperity of this fine establishment, the direction of which he intrusted to the learned mineralogist Brongniard. In 1804, the fabrication of soft porcelain was entirely given up at Sevres. Nevertheless, it must be confessed, as M. Brongniard very judiciously remarked, it required more research and more genius to compose this artificial porcelain by complicated and delicate processes, than to obtain the hard porcelain, which is the result of the simple mixture of two natural materials, kaolin and feldspar.

After this reform, the new director of the Sevres manufactory applied himself particularly to the composition of hard porce-

lain, giving it a whiteness and delicacy never previously obtained. In 1806, the Sevres porcelain was embellished by the superb green chromium, a metal discovered by Vauquelin.

To M. Brongniard's wise direction were owing the improvements made in the chemical mode of painting on glass, a new style of painting, which is done by mixing the metallic oxides with a flux composed of glass with lead.

It was under the empire that historical subjects were first represented upon porcelain, and especially upon very large vases. The painter, Van-Os, was called to France, in 1811, to paint flowers upon porcelain, and in this branch of art he was distinguished as much for the richness of his shading, as the brilliancy of his colouring. The fine paintings upon porcelain by Drolling, Lauglacé, George Constantin, and above all, Madame Jaquotot, are well known.

M. Charles Dupin speaks as follows:—

"By means of the new method of painting upon porcelain, perfected as it now is, the finest masterpieces of the greatest masters, which are liable to decay in the course of a few centuries, may be copied and consigned to posterity in a most beautiful and imperishable form. Mineralogy and chemistry have lent their aid to render this execution less expensive, more faithful, and more delicate than mosaic imitations."

The art of sculpture has also been of great advantage to the manufactory at Sevres, as regards beauty of form and figure. M. Fragonard, senior, to whom we owe such admirable ceilings, has contributed in no small degree to this, as our annual exhibitions fully attest.

In fact, the porcelain manufactory at Sevres owes numerous highly valuable compositions to the talents of this skilful artist. It is much to be regretted that private establishments have not imitated the royal manufactory in this respect. It is only by employing artists of undisputed merit that France has gained her great superiority in this art over all Europe.

Nevertheless, the efforts made at Sevres have provoked a for-

tunate emulation. M. Dihl, a skilful porcelain manufacturer, obtained the gold medal for the excellence and beauty of his performances. He had already received, in 1798, one of the twelve rewards, of the first rank, for paintings on porcelain with colours of his own composition, which experienced no change during the process of baking. This celebrated manufacturer also discovered a means of overcoming the difficulties attendant upon the composition and preservation of the colours appropriate to painting on pieces of glass of eighteen decimetres in length and breath. This operation required a distinct and peculiar process of application. He painted the same picture upon two surfaces of glass, so that in putting one over the other, one covered the other, and by that means doubled the vigour of the outline, and the depth of the colouring.

In 1810, the Paris authorities issued a decree for the erection of five public slaughter-houses, to take the place of the numerous private establishments of this kind belonging to the butchers. This was of great advantage to the city as regards health and safety. In order to enable the reader to understand all the benefits of this innovation, I will borrow from Mercier's *Tableau de Paris*, a detailed account of the inconveniences and the dangers presented by the former slaughter-houses.

"They are not outside the city, nor at its extremities, but in the midst of it. Blood streams through the streets, coagulates under your feet, and dyes your boots red, whilst mournful lowings salute your ears. A young ox is thrown down, his horned head fastened to the ground with ropes; a heavy club breaks his skull; a large knife makes a deep gash in his throat; his blood, which smokes, pours forth in volumes as he dies. But his groans, his muscles agitated by violent convulsions, his struggles, his gasps, his last efforts to escape from his dreadful doom, all speak the violence of his anguish, and the agony of his sufferings. His heart palpitates with fearful rapidity, his eyes become dull and languishing. Oh! who can contemplate all this

with tranquillity! Who can listen to the bitter sighs of a creature immolated to man!

"Sometimes the ox, stunned by the blow, but not felled, bursts his bonds, and becoming furious, makes his escape from his murderers, and attacks, as enemies, all whom he encounters. Spreading terror as he advances, he rushes on, every one flying in affright before the animal, who, the day before, entered the slaughter-house with slow and tractable steps. Women and children who happen to be in his path, are liable to be wounded, and also to meet with brutal treatment from the half-savage butchers in angry pursuit of their victim.

"These butchers are men of ferocious and sanguinary aspect; their arms are bare; their throat swelled by the predominance of violent emotions; their eyes inflamed, and their dress a mixture of blood and dirt; a knotty and massive stick is generally to be seen in their hands, a weapon much in request in their frequent scuffles and combats with each other. Misconduct is punished with greater severity in them than in men of any other calling. This is necessary in order to repress their habitual ferocity; and the custom has the sanction of experience."

Such was the state of the slaughter-houses until it was deemed expedient to remove these infectious establishments, the scenes of so many disgusting spectacles, to the outskirts of the city; and five slaughter-houses, on an enlarged scale, were erected in the neighbourhood of some of the *Barrieres*, and which are known by the names of the Montmartre Slaughter-house, the Menilmontant, the Grenelle, the Monceaux, and the Villejuif.

Thither are conveyed all the oxen, calves, and sheep destined for Paris consumption. The buildings are in airy situations; their dimensions are in proportion to the wants of the diverse sections of the city to which they respectively belong. Their construction, perfectly appropriate to the special destination of this new species of edifice, does honour to the intelligence and taste of the architect, M. Happe, who introduced into these monuments of public utility a vast, excellent, and commodious

distribution of parts, without destroying the external harmony and beauty as a whole.

In these immense slaughter-houses, the butchers slay all the cattle purchased, and divide it into portions for daily consumption, separate the hides, and prepare the tallow for sale. The vast number of animals killed in each of these five establishments, is of great advantage for various chemical purposes; for the facility in procuring gelatine, Prussian blue, strong glue, &c., is of course very great.

"In these establishments," says the author of the *Nouveau Dictionnaire des Origines*, "the useful has been allied to the agreeable. Each separate edifice is composed of several square buildings, all nearly upon the same plan. The enclosure is provided with gratings, which prevent the dangers attendant upon the escape of any animal. Outside is a high wall enclosing all the buildings. The square buildings, where the animals are slaughtered, are divided into equal spaces, the number of which corresponds with he number of butchers in Paris, who, in accordance with the rules of the establishment, have each his own *echaudoir*. Every *echaudoir* has two doors opening upon courts in opposite directions. One door is for the entrance of the living animals, the other for their exit, dead. In these *echaudoirs*, or slaughtering-rooms, are tubs to receive the blood, which is kept for various uses, and hydrants affording a plentiful supply of water for washing purposes, and which is kept up by means of ingenious steam-engines. In other parts of the building sheep-folds have been established, equal in number to the *echaudoirs*. There are, also, stables destined for the oxen and calves before they are killed. Other distinct departments are assigned to the melting of tallow, and the preparation of various other animal substances. The director, and other persons employed in the establishment, reside in the principal building. Finally, large well-aired garrets are in the upper stories, where the butchers deposite the skins for drying, until they can sell them.

CHAPTER XLV.

PUBLIC IMPROVEMENTS.

EMINENT and well-tried men, faithful executors of the master's idea, have directed the great *ensemble* of public and private improvements. To Chaptal, succeeded, in the capacity of minister, M. de Champagny, Duke of Cadore, who was in turn succeeded by Count Montalivet, in 1809.

This last-mentioned minister displayed superior intelligence, as well as zeal for the manufacturing reputation of France. Following the emperor's example, he encouraged and brought into notice the authors of new discoveries, and all the enterprising manufacturers of his age. His actions were the offspring of the purest and most enlightened patriotism. It was his ambition to contribute to the progress of improvement in the arts, and to render his life memorable by real services to his country.

It would be difficult to enumerate here all the great works begun and carried on under the administration of Montalivet. Canals were dug, roads made, bridges built, and monuments of every description undertaken: such are the remembrances of his useful career, to be seen in all parts of France. The embellishment of Paris was a subject which interested him deeply; it was, in fact, the principal object of his indefatigable zeal and activity. It is well known, that Napoleon wished to render this great city the finest of European capitals. His minister spared no pains in seconding his views. Several parts of the town were rendered healthy and agreeable, which were hitherto entirely wanting in both those qualities; new fountains sprang from the ground in many of the public squares; the large slaughter-houses, as we have just remarked, took the place of

the ignoble and disgusting butchers' establishments; triumphal arches, magazines, and marts for trade were erected; our magnificent Bourse rose from its foundation; and the *quais*, whose great and picturesque length is so much admired by strangers, were planned by M. Montalivet.

In the midst of all these diverse labours, and of many others no less interesting, this minister, endowed with extraordinary capacity, and powers of mind which enabled him to grasp the whole of an extensive plan, without omitting any of its minor details, did much for the country, by his vigilant care in providing for the sustenance of the French troops, that important and difficult part of the administration. "This minister," says Tissot, "understood all the various duties of his elevated office, and acted in all with the same judicious, penetrating, and economical spirit. His circulars, his daily correspondence with the authorities, the projects for decrees proposed by him, and afterwards taken as laws, now form the administrative jurisprudence of the ministry. His descriptions of the internal condition of France during the brilliant period of the empire, will remain as vast and faithful portraits of an epoch, when the genius of one great man created, commanded, and obtained prodigies.

On the 15th of August, 1810, the solemn inauguration of the column in the Place Vendôme took place, amid the joyous acclamations of the people. This gigantic monument to the glory of the *grande armee*, was begun on the 25th of August, 1806, under the direction of Lepère and Gondouin, architects of the first order. The cannon taken from the Austrians in the brilliant and rapid campaign of 1805, furnished the brass for this noble column, weighing no less than 900,000 kilograms.

It is an undeniable fact that the column in the Place Vendôme is a majestic relic of the warlike genius of Napoleon's epoch. It is an imitation in brass of the celebrated Trajan's pillar at Rome. It is two hundred and eighteen feet high, including the pedestal, which is twenty-one and a half feet in height. Its diameter is twelve feet, and the whole surface, in-

cluding the pedestal, the capital, and the top, is covered with plates of brass, ornamented with bas-reliefs. Those on the pedestal represent military scenes; the others, which ascend in a spiral line to the summit of the monument, represent the history of the victorious campaign, in honour of which the column was erected.

The foot is surrounded and ornamented by two hundred and sixty-four plates, so artfully joined as to present one united surface. As to the idea of surrounding the stone core of the column with brass, it is said to have been done at Constantinople during the lower empire. It has been complained that the alloy is not good. The complaint is a just one; for the secret of this composition, understood by the ancients, and rediscovered under Louis XIV., defied the efforts of the founders of the column in the Place Vendôme. There is too much pewter in the lower part, and not enough towards the top; which necessarily causes a very evident disparity of colour.

The bas-reliefs on the pedestal represent the arms and costumes of various nations conquered by Napoleon. Formerly, the ciphers of the Emperors of Austria and Russia figured upon the shakos or caps worn by our hussars and infantry, and upon other articles of dress; but peace having been concluded with Russia before the erection of the monument, Alexander's ciphers disappeared, and those of the Emperor Francis alone were retained.

A faithful imitation of Trajan's Column, that of the Place Vendôme is of the Tuscan order. The plinth supports a railing, from within which elevates itself a sort of cippus, surrounded by a hemisphere; this is the continuation of the column. The stylobatum, of white marble, having become damaged in consequence of bad weather, it was replaced in 1835, by a new one of Corsican granite, which is not composed of several steps as was the other. It is a sort of socle or plinth, apparently of a single piece, so well are the blocks united. Three steps cut in the marble lead to the entrance.

This column has undergone many political revolutions since its erection. A monument to victory, it experienced in 1814 the outrages of defeat. The troops of the allied powers which invaded France, tore down the colossal statue of Napoleon with violence; a statue which, from the summit of its triumphal pillar, seemed to rule over the whole world. By insulting the image of our hero, these barbarous soldiers hoped in some sort to pull the living man from his pedestal as easily as they had torn him from his throne; but posterity has undertaken to prove the folly of such an attempt. Time, which destroys all things, not only respects legitimate glory, but sanctions it, strengthens it, and transmits it from one generation to another.

It was impossible to ask at the hands of government the restoration of the statue of a man looked upon as a usurper. But after the revolution of July, government considered it a duty, and every one knows with how good a grace it was accomplished. The statue of the modern Charlemagne again stands upon its column. But he is no longer as at first, a half-naked warrior crowned with laurels, his right hand leaning on his sword, his left bearing a globe surmounted by victory. Now, Napoleon, the man of the age, is represented in a manner conformable to historical truth. In accordance with true good taste, the hero is clothed in his favourite costume, in which he won so many battles, and which has become so celebrated since Béranger has made it the subject of one of his most popular songs. "Now," as remarks the author of a recently published work (*Etudes physiologiques sur les grandes Metropoles de l'Europe occidentale*), Gaeton Niepoiré, "the Napoleon of the Place Vendôme is the same Napoleon in the cocked hat and gray cloak, who is so well known to all men, of all ranks and all capacities. It is he, in his dress, in his bearing, and even in his glance, which seems a continuation of one uninterrupted idea."

Let us now cast our eyes upon some of our manufactories; we shall find that they have not remained stationary during the empire.

Owing to the fortunate introduction of machinery at Sedan and Abbeville, great improvements were made in the articles produced. Great advantages resulted in particular from the substitution of mechanism for the old system of hand-labour; besides increased beauty in the stuffs, economy was an important result gained.

Amiens, that fine city, watered by the Somme, and which is so justly proud of its magnificent cathedral, the most admirable religious monument in France, next deserves mention for her cassimeres, which bid defiance to those of other countries. Her cotton velvets merit equal praise. It was at Amiens, that M. Gensse Duminy introduced the fabrication of the *patent cord*, a material formerly entirely monopolized by England, and sold there at an exorbitant price.

After the establishment of the Jouy manufactory, other similar ones were erected in the department of the Upper Rhine, for printed cottons; thus spreading ease and comfort throughout the country, and insuring results of a most fortunate nature. In 1806, the committee foretold a brilliant career to M. Mulhausen's manufactures, and gave M. Dolfus Mieg the silver medal for beauty of colouring and design; adding: "All those employed in the fabrication of the Mulhausen stuffs may behold in this medal a proof of the high opinion entertained by the committee, who have examined their stuffs with care, and pronounced them beautiful, excellent, and worthy of admiration." Afterwards, five manufacturers in this same town obtained the gold medal.

With the re-establishment of luxury, lace of all kinds came again into favour, and gave rise to the celebrated manufactories at Alençon, Chantilly, and Brussels, which took the first rank; and Le Puy, Arras, Valenciennes, Douai, and various other towns. Elbeuf, from the very beginning, gained a great name for her productions, which were brought down to the level of moderate fortunes, and increased in beauty without a proportionate rise in price. Flanders and Courtrai maintained their

former renown, whilst the cities of Côtes du Nord, La Sarthe, and La Mayenne, were distinguished by the strength, durability, and low prices of their goods. Cambrai, Valenciennes, and Saint Quentin, so remarkable for its *Hotel de Ville*, continued to fabricate lawns and batistes in great perfection. This last-mentioned town receives a fortieth part of the cotton annually imported into France, and has established numerous workshops where the machinery is made, and now employs nearly seven hundred workmen.

We must not omit to mention the successful efforts to introduce into France the worm which produces white silk.

Formerly, the only silk-worm known in France was that which produces the yellow cocoon; but this could not be made into white silk, except by submitting it to operations by which its strength was materially diminished. Roard, a manufacturer and chemist, made great improvements in the art of bleaching yellow silk. But the white colour obtained by his process faded by degrees, and acquired a yellowish tint.

The only means of obviating this difficulty was to import the other species of worm from China; a worm which produces silk of a perfect whiteness, and which from its origin is called *sina*. Some attempts had been previously made to introduce this worm into France; but the troubles of the revolution had interrupted them, and the project was abandoned.

The imperial government, enlightened by the advice of the consulting committee of arts and manufactures, brought it again into notice, and offered rewards to those who would undertake the propagation of this precious species of silk-worm. About the same time (1808,) the society for the encouragement of the arts offered a prize of two thousand francs to the proprietor who would undertake this new office on the largest scale. The results were of the most advantageous kind. From that time, the cultivation of this valuable chrysalis extended more and more; the silk produced is sold at a higher price than that of the ordinary yellow cocoons, but is nevertheless much sought

after, and great encouragement is afforded to those who have undertaken the care of this new species of silk-worm.

It cannot be denied that silk-weaving owes its many modern improvements to the new machines invented in the beginning of this century. "Those in previous use," as the Baron Charles Dupin remarks, in his work entitled *Progres de l'Industrie Francaise*, "were inconvenient on account of their being so very complicated. They were provided with numerous strings and pedals; they required the labour of several individuals to keep them in motion. Those employed in this wearisome occupation were principally young women and children, who during the whole day were obliged to remain in painful attitudes, by which their limbs often became deformed. Indeed, some contracted mortal diseases."

All these dangerous effects disappeared upon the invention of Jacquard's mechanism; the name of which is at the present day so justly popular, as we have before had occasion to remark when we gave a description of the services of this eminently useful man.

Among the inventions of machinery useful in facilitating and perfecting the weaving of silk, we must mention that of the mechanician Briard, of Rouen, an ingenious machine, which received the name of Briarde, from that of its inventor.

Ravrio.

CHAPTER XLVI.

BRONZE ORNAMENTS.

DURING the first years of the empire, the art of casting and moulding bronze was of valuable assistance to luxury, by providing ornaments for rooms and table-services. It is not here necessary to speak of the great and bold labours, of which Jean Balthazar Keller possessed the secret, when, with metal weighing eighty thousand pounds, he made, in one single operation, the magnificent statue of Louis XIV., which was erected in the Place Vendôme, and the fine statue called the *Knife-grinder*, now to be seen in the garden of the Tuileries.

The revolution, by dispersing and scattering all large fortunes, opened the way to new improvements in the art of making groups and statues of bronze. This substance, almost equal in

beauty to gold and silver, for ornaments, appeared to the artificer, and many of his economical customers, far preferable on another account; and it was often brought into rivalship with porcelain and crystal; and on tables, in saloons, boudoirs, and other apartments, bronze, in various beautiful forms, added to the sumptuousness and the elegance already displayed.

The day for large statues of bronze, placed in the vestibules of fine houses, has gone by. But that of graceful little miniature figures of all kinds and varieties is now at its height.

The skilful and modest Antonin Moine has contributed much to the beauty of this fashionable art.

It is much to be deplored that, in bronze ornaments, there are many wide aberrations from the direct road of good taste. For instance, the makers of vases, lustres, and clocks follow the same unvarying design in all; and the heavy branches so ungracefully placed upon the antique candelabra, which were once so slender and graceful, deserve reprehension as well as the *epergnes*, in which the eternal basket of flowers is supported by the eternal female figures. Nevertheless, thanks to the improvements of several skilful founders, and French artists, our ornaments of bronze are considered superior to those of all other nations. This superiority is principally due to the beauty of our sculpture, and the elegance of the forms after which they are modelled. This important point, upon which so much depends, deserves the attention of all our workers in bronze, who are jealous of the prosperity of their admirable art.

Until now, no country has been able to compare with France in respect to working in bronze. Paris has borne the palm, and has never feared the rivalship of any other city. But let her beware! carelessness and bad taste may cause her insensibly to lose this superiority.

The artist who, under the imperial government, best sustained the reputation of our bronzes, was indisputably the great Ravrio. It will be seen hereafter that this was by no means his only claim to the eulogium of posterity.

Antoine André Ravrio, born at Paris, in 1759, was the son of a master-founder attached to the Riesener family, so well known for their improvements in the liberal and manufacturing arts. Intending to follow the trade of a bronze-gilder, he was anxious to obtain accurate knowledge in every branch of his art. He had learned to cast under his father's direction; he designed and modelled at the academy, and studied carving under the best masters. By this means, the perfection of every thing he undertook spread his reputation over all Europe. His performances are distinguished for the exquisite purity of the design; the noble simplicity; the ingenuity of composition; the fine imitation of the beautiful forms of antiquity, and a degree of good taste which never failed him.

To his remarkable skill in this art, Ravrio united a vast fund of information, an amiable disposition, vivacity, and the best qualities of the heart. In his leisure hours, it was his delight to cultivate a taste for writing light verses; and the happy inspirations of his merry muse assure us that if he had been able to devote more time to his graceful lyrical compositions, he might easily have taken his place among our most distinguished poets in that line. Almost all the pieces which compose his two volumes of poetry, display ease, grace, humour, and good sense, united with wit and feeling.

But let us leave the poet and return to the artist, in order to mention a trait which does him no less honour than the most magnificent productions of his art.

Before closing his laborious and brilliant career, Ravrio, actuated by a tender solicitude for his former fellow-workmen, offered a prize for the invention of any process for preserving gilders from the dangers inseparable from using mercury.

The following account by M. Charles Dupin will place Ravrio's conduct in its true light:—

"A celebrated artist," says he, "who cultivated the arts under two different epochs (for he was born in 1759, and died in 1814), M. Ravrio, produced first the bronze ornaments in the

style of Louis XV., and afterwards the classic ornaments in vogue during the empire. He terminated forty years of labour by an action which may be termed an improvement in the arts, and a benefit to humanity. He bequeathed, by his will, a legacy of 3,000 francs to the author of a process for putting a stop to the terrible consequences of gilding metals. The old method brought on, it is true, dreadful infirmities, and premature death. A short time afterwards the prize was gained by M. D'Arcet, now a member of the Academy of Sciences. His ingenious process obviated entirely the mercurial emanations, formerly so fatal to gilders."

Unfortunately for themselves, the workmen are too apt to neglect the advantages arising from M. D'Arcet's invention. Notwithstanding the law on this subject, and the obligation imposed upon gilders to construct forges which would not be injurious to the health, some of them persist in following the old method of gilding. Numerous journeymen gilders are in this manner exposed to dreadful accidents, and incur mortal diseases. M. Gaultier de Claubry relates that, fifteen years ago, three workmen perished at Turin, whilst employed in gilding a piece of work too large to be placed under a chimney.

In order to give an idea of the bronzes of Ravrio, we may here instance a rich branched candlestick, which held twenty-two candles, and was beautifully gilded and chased. The statue was three feet in height. The height of the whole was seven feet. Ravrio's performances of this kind are very good specimens of the taste prevalent during Napoleon's reign.

At the same period, another Parisian, Michel Brézin, a skilful founder, rendered eminent services to the artillery of our victorious armies. From his foundry issued the greater number of the cannon before which the Austrians, Prussians, and Russians trembled. Brézin succeeded in boring cannons placed in boats, in front of the *Quai des Augustins*. This operation was performed by means of an ingenious mechanism, set in motion by the action of the water. Afterwards, this industrious me-

chanician brought this invention to a greater degree of perfection. He acquired an immense fortune as much by his efforts as by the fortunate concurrence of circumstances; but, what is more worthy of the admiration of mankind, he wished to dispose of his property in favour of the workmen who had *assisted him in gaining it.* Such are the very words of his will. In order to realize this benevolent idea, which presented itself to him rather late, he left, at his death, in 1828, a capital of nearly 5,000,000 francs for the establishment of a hospital for the reception of three hundred old men, of sixty years of age, who had been employed in any one of the trades more or less connected with that in which he had been so successful. This building, in accordance with Brézin's express wishes, is called the Hospital of Gratitude, and is on the estate of the founder, called *Le Petit l'Etang,* in the district of Garches, circuit of Versailles. There, in a pleasant and healthy situation, three hundred old men are provided with all the comforts of life, and end their days happily.

"Honour," says M. Charles Durozoir, "to the man whose last thoughts tended to the conception and developement of this idea. Such are some of the wonders of science. Through its means a simple mechanic may, like Louis XIV., found an *Invalides.* The workmen for whose benefit this hospital is designed, are smiths, locksmiths, and various workers in iron, copper, wood, &c."

CHAPTER XLVII.

AGRICULTURE.

IT might naturally be supposed, that, during Napoleon's warlike reign, agriculture was neglected; but this was by no means the case. Active and intelligent agriculturists were zealously employed in putting into practice new methods of improving the produce of the fields, and spreading ease among the rural population. In several parts of France, especially Flanders, Artois, Picardy, Normandy, L'Ile de France, and Alsace, flourishing farms existed in a state of great prosperity, thanks to the improvements of men whom we shall hereafter have occasion to notice. It was impossible to enter one of these farm-yards without at once recognising the salutary effects of order. They generally presented a large square court, from the midst of which arose pyramids of logs of wood, and high stacks of straw surrrounded by stables, sheds, and other buildings,

under which were ranged the wagons, carts, harrows, rollers, and other farming instruments. Not far off stood the pig-sty and poultry-yard; at the entrance of which stood the vigilant cock, like a sentinel.

In the centre of all proudly arose the dwelling-house of the family. How different from the farms in Berri and Languedoc! A square piece of fallow ground without enclosure, a meager building, of which the lower story was used as a stable and granary, and the upper served as a habitation for the family of both sexes; around this almost impenetrable cave lay heaps of rubbish and dirt, or pools of stagnant water, in which ducks and geese endeavoured to find some slight amusement, whilst a few starving fowls dug up the earth with their beaks.

At the time when the decennial prizes were offered (1810), honourable mention was made of M. Bonneau, a distinguished agriculturist of Brosse (Indre), for the experimental farm which he had established, and where he had created every thing himself. In this farm, which was undoubtedly the first *model farm*, nothing was done upon the old plan merely because it was the old plan; science directed all the experiments; new manure made according to chemical rules and an intimate acquaintance with the laws of vegetation, was used. By a just application of geometry and the laws of motion to the plough, he obtained economy of time and great perfection in tillage. Experiments were daily made upon the means of improving the race of sheep, and naturalizing those from other countries. All tended to the increase of the revenue of the farm. Artificial meadows produced a twofold harvest, at the same time that they gave the soil the necessary rest, if a cereal harvest were desired in future.

Establishments of this nature have in a great degree contributed to the rapid improvements made of late years in agricultural instruments, such as ploughs, harrows, turnip-cutters, extirpators, and even the simple cart, used for the transportation of fruit, vegetables, and other articles, to a neighbouring market.

Many other ameliorations will fall under our notice when it becomes our duty to describe the model farm of Roville.

During the wars of the republic and the empire, which had in a measure deprived France of all colonial supplies, indigo became very rare and very expensive; so that it was found necessary to give up the use of it, and resort to the cultivation of woad, a biennial plant, with a hairy branching stem, which grows to the height of three feet. "A long time before the discovery of indigo," says Chaptal, "woad was cultivated in all countries. It made excellent fodder for cattle during the winter. But it was less cultivated as fodder, than as an element of the only solid blue colour known before the seventeenth century. Two hundred thousand bales of woad were annually exported from Bordeaux for dyeing purposes."

At the first introduction of indigo into Europe, every one foresaw the injury this Indian plant was about to cause to woad; for when divested of all foreign matter, indigo presents about seventy-five times more colouring matter than the same weight of woad. Henry IV., who foresaw the entire abandonment of the cultivation of woad, which was one of the principal branches of French agriculture, determined to arrest the progress of the evil whilst it was yet new; and by an edict of 1609, forbade, under penalty of death, the use of *the false and pernicious Indian drug.* The German, English, and Dutch governments imitated this severity, although the interest felt by them in this subject was much less in reality than that of France; but the prohibition was only continued for a short time in England.

The time arrived when Henry IV.'s anticipations were fully justified. Our vessels, kept in port by fear of the English, who were masters of the seas, were unable any longer to go in search of indigo, and we had nothing but woad to take its place. In this state of privation and distress, the French government applied to her learned men for a means of procuring from our own soil the resources we had hitherto obtained in America. Before long we succeeded in obtaining, from woad, indigo of a superior

quality. Three great establishments were erected at the public expense, to carry on this branch of art. These establishments prospered for several years, but were given up during the political changes in 1815.

A skilful dyer of Albi, named Rouquès, maintained for ten years an establishment of this kind by his own unassisted efforts, and made use of no other indigo than that which he himself prepared with woad.

The optician's art, which originated in the thirteenth century, according to some, with Alexander Spina of Pisa, and according to others, with the celebrated monk, Roger Bacon, is a valuable one to science, and a useful one to humanity. Improved upon by Metius, Galileo, Corneille Drebbel, Repler, Newton, and other illustrious men, it has been cultivated in France with great success since the beginning of the empire, and now forms one of the finest and most interesting branches of national industry.

This art is not, as many persons ignorantly think, a common and vulgar one. It requires the skill of an artist combined with the capacities of a learned man. Much more is necessary than mere sleight of hand, to execute the instruments used by philosophers, astronomers, engineers, and mariners, in their respective professions. "There is, perhaps," says a learned man, "no vocation which calls for more varied information than that of the optician. He must understand filing, turning, soldering, glass-blowing, polishing surfaces if need be, let them be plane, convex, or concave, and giving them the proper curve. Having in all ages been in close contact with mathematicians, astronomers, and other men of science, his profession has necessarily elevated itself above that of other workers in glass, metals, &c. Indeed, in some cases, his discoveries have given him a reputation equal to that of the most distinguished men."

CHAPTER XLVIII.

CHEVALLIER.

IT is our delight to signalize the brilliant efforts of one of those privileged artists, who, during the empire, spread his renown throughout the whole civilized world. There are, in fact, few people who have not heard of the engineer Chevallier, of his celebrated thermometer, and of his exact and interesting meteorological observations.

Jean Gabriel Augustin Chevallier, born at Mantes (Seine et Oise) in 1778, betrayed at a very early age a decided bent for the art which he afterwards brought to so great a degree of perfection. He received his first ideas of this nature, so to speak, upon the knees of his maternal grandfather, François Trochon, an excellent engineer and optician, and a lieutenant-counsellor of the king at the election of Mantes and of Meulan.

The progress made by the young Chevallier was very rapid; but, ambitious to distinguish himself in his career, he neglected nothing which could contribute to enlarge the circle of his acquaintances among those who would assist the developement of his genius, and assign him a place among opticians of the first order. Thus, he studied the elements of meteorological science under the learned Javinien Leblond, professor of mathematics, who honoured him with his friendship. Afterwards, he studied the difficult art of constructing mathematical and philosophical instruments with precision: in this he was guided and directed by the wise instructions of the celebrated Assier-Perricat. This was in some sort, a national victory, for this branch of art had previously been entirely monopolized by Italian artists in France.

The illustrious astronomer Lalande was a witness of the early success of Chevallier; and, eager to encourage his attempts in favour of science and national honour, would confide to no other the making of all the instruments used by him. Our young artist also obtained great encouragement from the learned Alexis-Marie de Rochon, a member of the Institute, director of the observatory at Brest, and inventor of the rock-crystal micrometer; and afterwards gained the esteem and confidence of Fourcroy, Chaptal, Baumé, and the immortal Cuvier, as well as of the learned surgeons Boyer, Pilletan, and Tenon.

In 1796, M. Chevallier, at the age of eighteen, succeeded his grandfather in his establishment situated in the clock-tower of the Palais de Justice.

It was not long before our skilful optician made this establishment a celebrated one. Such it well deserved to be, for it had been founded by his family in 1740, and is undoubtedly the most ancient one of the kind existing, not only in France, but in all Europe.

In this Gothic tower, this dark vestige of ancient Paris, M. Chevallier has, for more than forty years, devoted himself zealously to his art. Here are his magazines, his workrooms, his laboratories; here, also, may be seen his thermometer, so frequently consulted, and which shows all comers the exact temperature.

Since the hour of his installation in this venerable monument of feudal ages, M. Chevallier's labours have presented an uninterrupted course of ingenious improvements, and remarkable inventions. In 1801, he produced the mechanical barometer, which received honourable mention from the Lyceum of Arts; in 1806, he brought some of his areometers to great perfection, in concert with Cadet Devaux, the chemist. About the same time, he gave to the public his double opera-glasses, now in general use in the fashionable world. Afterwards, in 1821, he produced the isocentric glasses, the eminent superiority of which was established by Baron Menzel, a skilful oculist, and also by

the eulogium pronounced upon them by the Royal Academical Scientific Society.

During the few years following, he invented numerous eye-glasses, very superior to those in previous use, as well as an alembic for trying the quality of wine, and the Selligue microscope, approved of by the Academy of Sciences.

In 1839, M. Chevallier obtained a reward from the Athenæum of Arts for the new pancratic microscope, executed upon the plan of Professor Fischer, of Moscow. This instrument is of small size, and has the very great advantage of rectifying objects, and possessing a variable magnifying power, without giving the operator the trouble of changing the lenses, as in other microscopes.

Finally, at the present time (1840), he is occupied in giving to the public, together with M. Quevenne, principal pharmacopolist of the Hospital *de la Chute*, the Quevenne Lactodensimeter, an instrument whose object is to discover the precise nature of milk, and to ascertain if any foreign articles have been mixed with it.

Among the inventions above enumerated, is one particularly worthy of the gratitude of all those whose sight is not good. I speak of the blue isochronic glasses, which are of great assistance to the eyes, without fatiguing or weakening them.

Chevallier's services to science, and to society in general, did not end here. Before his day, meteorological observations had been much neglected. He was the first who made them the subject of his constant study. He continued them and published them daily for forty years, for the climate of Paris. It is in imitation of his example that similar observations have been made in all parts of France.

We must not omit to mention the optic scale invented by M. Chevallier in 1811. By the aid of this most ingenious instrument, the use of which has been highly approved of by the most eminent practising oculists, the difference existing between

eyes of unequal power may be accurately ascertained, and adjusted by means of glasses of different focus.

As to the numerous optical and mathematical instruments which M. Chevallier's genius has produced, every one is acquainted with their remarkable excellence. In 1823, the learned Arago offered them the tribute of a public eulogium; and the Baron Charles Dupin, a competent and well-informed judge, did them justice in the report of the committee upon the exhibition in 1834.

Not contented with exercising his talents in the practice of his art, he consigned its rules to various theoretical works, the fruits of his long and well-directed experience. Such are his *Instructions concerning Horizontal or other Sun-Dials*, from 1805 to 1808; The *Sight-Preserver*, a valuable work, which passed through four editions, and was dedicated to the King of Westphalia, who testified his gratitude to the author, his own instrument-maker, by sending him a very valuable ring, enriched with diamonds; *The Use of Spectacles*, 1814, in octavo; *An Essay upon the Art of making Glass Instruments for Experimental Philosophy*, 1819, in octavo. This work, ornamented with fifteen plates, treats of all that relates to the construction and perfection of various glass instruments. It presents a new and complete theory of areometers as applied to sciences and chemical arts. *Instructions in the Use of Lightning-Rods*, 1825, in octavo. Finally, a number of memoirs and scientific letters, inserted in the papers at different times.

With such claims upon celebrity, it is by no means astonishing that M. Chevallier has obtained distinguished honours as an artist. Several academical societies, especially the Athenæum of Arts, the French Society of Philosophical Sciences, the Moscow Imperial Society of Naturalists, the Imperial Agricultural Society of the same place, the Royal Academy of Sciences, at Metz, Amiens, &c. &c., have deemed it a matter of pride to enlist him among the number of their members or correspondents. Numerous badges of orders have been awarded to him, both in

France and other countries, as well as medals at three successive exhibitions. Under the empire, Chevallier was often honoured with Napoleon's praise of his philosophical instruments. He was at that epoch contractor for instruments for the imperial crown, and in that capacity sent many of his inventions and improvements to the palace at Rome. Under the restoration, his merit gained him the place of optician to the king and princes, and engineer to the pages of the bed-chamber. Louis XVIII., who esteemed him highly, gave him several private audiences. To conclude, he is at the present day royal optician, and continues the study of the science which has made him so celebrated.

We will add a few last words upon the character of Chevallier. Endowed with a noble and disinterested heart, he delights in encouraging and rewarding zeal and talent among those of his own profession; far different from those egotistical artists, who, overlooking everything except their own profit, are not ashamed to enrich themselves by oppressing those in their employ. M. Chevallier is, like Sebastian Erard, the model of a good master; his treatment of those about him being always mild, affable, and conciliating. This course of conduct produces a spirit of emulation among the workmen, each one endeavouring to attain the degree of excellence aimed at by him in every thing made under his direction. One has but to enter his shops and workrooms to see how much he is beloved and respected by his workmen. It seems like one extensive and laborious family, where all are happy if they can but fulfil the wishes of him who is at their head, and thus prove their affection for him.

CHAPTER XLIX.

MANUFACTURES—RICHARD LENOIR.

AMONG the names which rank high for having, in a great degree, contributed to the commercial prosperity of France, is that of the celebrated Richard Lenoir: one equal to that of Oberkampf, and which will always be mentioned with respectful gratititude in all the workshops of the Faubourg Saint Antoine.

François-Richard (known as Richard) Lenoir, born on the 16th of April, 1765, at Trélat, a little village of Calvados, belonged to a family of poor farmers. Endowed with an active and inventive imagination, he manifested, from his earliest childhood, a decided inclination for trade. At the age of twelve, he undertook the care of a number of pigeons, and earned a small sum of money by selling them. The lord of the district put a stop to this commerce,—but not until Richard had sold all his pigeons; and, with the forty-two francs they brought him, had procured himself a pair of hob-nailed shoes. Hitherto he had worn wooden ones, like those of his playfellows.

To the trade in pigeons succeeded that of a handsome race of dogs; and Richard's gains were evinced in the striking difference between his costume and that of the other boys in the school. Having learned to read and write well, he was intrusted with the keeping of the register of the cattle-market, which was held every Wednesday, at Villiers le Bocage.

Actuated by a love of traffic, and a desire to enrich himself, he left his father's residence at the age of seventeen, well provided with clothes, but having only twelve francs in his pocket. He remained at Rouen for a short time, in the employ of a dealer

in printed cottons; but, by some unfortunate chance, instead of being allowed an advantageous share in the business, Richard found himself obliged to perform various servile offices for his employer. Finally, disappointed in this, he hastily left the situation for that of a lemonade-seller, hoping thereby to amass a sufficient sum to enable him to go to Paris.

A year afterwards we behold him in that city, struggling against the numerous difficulties which a beginner always encounters. He served as a waiter in a coffee-house in the Rue Saint Dénis, for a year. He there made a capital of one thousand francs, and resolved to go into trade. Hiring a room in a sixth story, in the Rue Saint Honoré, in the neighbourhood of the *Piazza*, he purchased several pieces of English dimity, then very rare in France, and to insure a sale, carried them from house to house. Six months had hardly passed before Richard was in possession of 25,000 livres.

The revolution broke out; but if we except a few unimportant accidents, it had no effect whatever upon Richard's ever active spirit. He took a commodious shop in the Rue Française, and was so fortunate in his speculations as to be soon able to become the possessor of the fine estate of Fayt, near Némours. At the earliest intimations of the approach of the period so justly termed that of terror, he had the good sense to suspend his commercial operations, which would rather tend to endanger him than otherwise. Summing up his gains with his partner, he left Paris to pay a visit to his relations, then residing in the village of Epinay.

Richard's arrival at home seemed a sort of providential circumstance. Hardly had he crossed his father's threshold, when bailiffs presented themselves for the arrest of the old man. He had gone bail for a tax-gatherer, who had absconded with the funds in his own possession. The son satisfied their demands, and proved thereby that the twelve francs he had carried away with him ten years before had not lain idle.

After passing two months with his family, Richard returned

to Paris, and to his former trade now added that of a lapidary, which he found extremely profitable. Chance brought him into contact with a young merchant named Lenoir Dufresne. Both had resolved to buy the same piece of English cloth. Being pleased with each other, they bought it together, and soon after entered into a partnership, which was only dissolved by the death of Lenoir Dufresne. Their establishment attracted such crowds of purchasers, that at the end of six months their sales amounted to fifteen hundred francs a day, and at the expiration of a year, their daily receipts rose to the sum of 4,000 francs. Finally, when they made their inventory in fourteen months, they ascertained that the 6,000 francs they had invested in the business had produced a revenue of 112,000 francs. Their great profit was upon English goods.

"The time had now come," says a well-informed biographer, "for Richard to become himself the manufacturer of the cotton stuffs, in which he had so long speculated and with so much success. The longer he pursued this branch of trade, the more anxious he became to discover the secret of their fabrication. Chance revealed it to him. One day, during his partner's absence, he amused himself with ravelling the threads of some English goods: he weighed these threads, and ascertained that a piece of eight yards in length, and worth eighty francs, only weighed eight pounds, and could only have been valued at twelve francs in its original state; consequently, sixty-eight francs remained for the working up. This was a new light upon the subject. But the question now was, how to procure the raw material; for England was the great cotton mart: it was there that this substance was received, spun, and manufactured. The difficulty was a serious one, but commercial enterprise was able to surmount it.

From that time, Richard entertained the patriotic idea of setting France free from the sort of tax now imposed upon her by England. Animated by this noble ambition, he triumphed over the doubts and fears of his partner, and set himself to work.

His first two looms were set up in a public house in the *Rue de Bellefond*, and dimity, similar to the English, was woven. Lenoir discovered the method of figuring it. A spinning-factory was now necessary to the prosperity of the new art. Richard had twenty-two *mull jennies* constructed at a great expense, with carding-machines and trundles. These he established in a large house in the *Rue de Thorigny*, in the *Marais*. The stuffs sold well and rapidly; for they were believed to be of English manufacture. In want of space for his rapidly-increasing machines, and under the daily necessity of procuring new workmen, Richard, trusting to the protection of the First Consul, Bonaparte, took a sort of military possession of the deserted buildings formerly known as the Convent of Bon Secours.

Causing the vast apartments to be repaired with the rapidity of enchantment, he filled them with his workmen. Napoleon, hearing of this invasion, paid a visit to the establishment, and expressed his approbation of the activity so conspicuous in every department; he witnessed with much pleasure the process of bleaching the cotton, and testified his high opinion of the two manufacturers, by giving them permission to occupy the former Convent of Trênelle, situated opposite to that of Bon Secours.

It was then that this new branch of trade underwent the immense developement which distinguished it above all others; and then were reaped the enormous profits amounting to 40,000 francs a month.

Nevertheless, encouraged by their extraordinary success, Richard and Lenoir redoubled their activity in extending their labours. Before long, three hundred looms were established in various villages of Picardy; forty in Alençon; one hundred *mull jennies*, and more than two hundred weaver's looms, in the Abbey of Saint Martin, near Luzarches. An arrangement was made by them for giving employment to all the women who were in jail at Alençon. The Abbey of the Benedictines was used for this purpose, and the Abbey of Aulnay was opened to six hundred workmen.

After the death of his partner Lenoir (1806), which was an occasion of great sorrow to all the poor of the Faubourg Saint Antoine, Richard, now universally known by the name of Richard Lenoir, continued his calling with all his former zeal. He introduced spinning-factories at Caen and L'Aigle, and a cotton-printing establishment at Chantilly, and undertook the cultivation of cotton. His annual profits, at that time, were estimated at 1,200,000 francs. He was now at the summit of his prosperity. In 1801, the new tax laid upon cotton struck a blow at his establishments. The union of Holland and France increased his financial embarrassments. In vain Napoleon obliged the treasury to advance him the sum of 1,500,000 francs; in vain Richard Lenoir metamorphosed his cotton-mills into woollen-mills. The disasters of 1813, and especially the law of the 25th of April, 1814, which suppressed entirely and without indemnity the former taxes upon cotton, were the precursors of heavy calamity to manufacturers. This active man, who, at a time by no means generally prosperous, had employed 20,000 workmen, was completely ruined.

Richard Lenoir had received the Cross of Honour from the hands of the emperor himself. He was a member of the Council for Stuffs and Manufactures, and one of the company of Paris manufacturers. Made colonel of the eighth legion of the National Guard on the 8th of January, 1814, he distinguished himself in the defence of the capital, no less by his courage than by the generous humanity evinced in succouring the wounded.

This honourable citizen, so remarkable for his enterprising spirit, died on the 19th of October, 1840, at the age of seventy-eight.

"His obsequies," says one of his biographers, "were celebrated on the 20th of October, with great pomp. The procession, leaving the house of death in the Faubourg Montmartre, consisted of an innumerable concourse of mechanics, and received new additions at every step. Arrived at the manufactory of Bon Secours, they paused, in accordance with the wishes of

Lenoir himself, who had expressed a desire to be carried thither after his death, and to be for the last time surrounded by those to whom he had been so fond a master. In the centre of this magnificent building, the workmen had raised a monument combining simplicity with grandeur. Above the bust of Richard Lenoir stood the statue of Napoleon; on the front of the pedestal were inscribed these words: *The emperor lends fifteen hundred thousand francs to Richard Lenoir.* On the other side: *Richard Lenoir marches to the defence of Paris at the head of twenty thousand united workmen.*"

CHAPTER L.

THE CATACOMBS.

BEFORE terminating our account of the period of the empire, and being present, as it were, at the funeral ceremonies of that great epoch, let us turn our reader's attention to the fearful galleries of death, known by the name of the Catacombs; those immense subterranean vaults where lie the bones of thirty or forty generations.

The great labours to which the creation of the Catacombs gave rise, labours which were not finished before 1810 and 1811, were undertaken in 1786, 1787, and 1788. It was the prefect of police, Lenoir, who first proposed the plan of transporting to the old quarries under Paris all the human remains in the cemeteries of that city, and that of the church *des Innocents* in particular, which for seven centuries had been the receptacle for the dead of all the surrounding parishes. This wise measure was one of the greatest importance as regarded the public health; but the events of the revolution did not permit it to be immediately carried into effect. It was not until the end of Napoleon's reign that time was found, and opportunity, for finishing this sepulchral monument, the only one of the kind in all France.

The Catacombs are situated between the Barrière d'Enfer and the Barrière Saint Jaques, beneath a plain called the Isoire or Isoard tomb. The entrance is by three great stair-cases, the largest of which communicates with the upper regions at a place called the *Fosse aux Lions;* the second stair-case is under the mills at Montsouris, and the third, the most frequented, is at the Barrière d'Enfer. One cannot with safety enter this subterranean necropolis without the aid of guides and torches. You go down a narrow stair-way (which admits but one person at a

time), a distance of thirty metres, until you reach the dominion of death. Here you behold human bones from the floor to the ceiling, arranged in the form of pyramids, obelisks, and columns. Three festoons of skulls form a sort of cornice to these architectural singularities. Inscriptions show to what cemetery, and to what church these skeletons were originally consigned. The remains of the victims of the revolution have a spot assigned to themselves.

There is also in the Catacombs a collection of minerals found upon the spot. Another curious collection, and one which is particularly interesting to physicians, is composed of the bones of all those who died of the same disease. These are placed in order, according to the nature of the complaint. There is also an assemblage of skulls, remarkable for size, shape, or anything which may render them objects of curiosity, or, what is better still, of scientific study.

The most remarkable circumstance to be observed in the Catacombs, is the free ventilation throughout. The method by which this is effected is extremely simple, but at the same time very ingenious.

"The renewal of the air in the Catacombs," says M. Nestor L'Hote, "is effected by an ingenious system of ventilation, which acts throughout, and is sufficient for the needs of the place. For this purpose a wall has been built around the walls which traverse the Catacombs, and supply the houses above with water. In this wall numerous holes have been made, the stoppers of which are removed when a want of air is experienced in the Catacombs. The men whose business it is to regulate the ventilation of the Catacombs, are able, by an accurate knowledge of the sun's altitude, and the direction and force of the wind, to seize upon the precise moment for introducing the greatest possible quantity of air into the vaults."

Finally, the present destination of the Catacombs, their lugubrious aspect, and the solemn thoughts which naturally fill the

mind upon witnessing these silent galleries of the dead, have caused various inscriptions to be placed upon the walls, taken, for the most part, from authors of distinction, poets, and philosophers of ancient and modern times, and always in harmony with the place itself. There is also a register kept, in which visiters may inscribe their emotions and impressions for the benefit of future visiters.

CHAPTER LI.

CELEBRATED MECHANICS—NATIONAL REVERSES—NAPOLEON'S DOWNFALL.

THERE are many names which we might have enumerated in our cycle of talented manufacturers, whose labours have sustained and augmented the glory of the mechanic arts. We might, for instance, have made mention of Kochlin, distinguished as a cotton printer; Chevenard and Sallandrouze as makers of carpets and curtains; Jacob Desmalter, universally known for his furniture; Bordier Marcet, for his improvements in lighting rooms, and many others whose names stood at the head of arts and manufactures during the empire. But all these will find a place in our work, when, in the progressive march of French industry, we reach that portion included in the period between 1814 and the present day.

Every one is well acquainted with the calamities which accompanied the latter years of Napoleon's reign,—putting a stop to manufactures and trades of every description. There was no more business, no more improvement in the arts; commerce was in a languishing condition. The whole of our national activity seemed to be concentrated upon our arsenals and weapon-making establishments. Our reverses in Spain; the disastrous campaign in Russia; the traitorous defection of our allies, and the invasion of France by the northern hordes, were so many successive blows at all branches of industry. After a truly marvellous struggle, in which Napoleon displayed all the resources of military science, and in which he overcame the enemy twenty times, he found himself, although weakened by the effect of his victories, still in a condition to oppose all Europe,

at the head of his brave and faithful soldiers. But what froce could not accomplish, was, in the end, consummated by treason and dark diplomacy. The gates of Paris were opened to the enemy; and the emperor, to prove his devotion to France, renounced, for himself and his heirs, the throne which he had made so glorious. He who had elevated this throne; he who had re-established peace among us, and dispersed factions; who had lifted the crown from the dust, as has been energetically said, was imprisoned in a little island in the Mediterranean by the very kings and emperors who had met with such generous treatment at his hands. He was stigmatized with the name of usurper!

Then ensued his brilliant return from Elba, and the general enthusiasm excited by his rapid passage through the country. Thousands of descriptions have been given, and will still continue to be given of the great events of the new reign of one hundred days.

The battle-eagle again spread his wings over opposing armies; and, for two entire days, filled them with astonishment, and obliged them to yield to his victorious thunders. But the fatal hour was not yet arrived. The great man was destined to fall again. A panic seized upon our youthful soldiers; they fled in disorder, as on the fatal fields of Crécy, Agincourt, and Poitiers. The English and the Prussians could scarcely credit their own triumph; and this victory's first infidelity decided Napoleon's fate for ever.

The emperor did not wish to survive this catastrophe. He threw himself, sword in hand, into a battalion; but the flying cannon-balls appeared to respect him. His generals and staff-officers seized his horse's bridle, and obliged him to follow them at a gallop.

At the battle of Waterloo the old imperial guard sustained the former French glory by their heroic devotion to their emperor's cause. It was at the most desperate part of the conflict. "Cambronne," says M. Alexander Dumas, "interposed himself

with the second battalion of the first regiment of light infantry between the English cavalry and the fugitives, and forming a square, drew the enemy's attention to himself and his battalion alone; and, closely surrounded and pressed on all sides, he fought until obliged to surrender. Upon this occasion he made use, not of the flowery phrase ascribed to him, but of a single word, a soldier's expression, it is true, but one whose energy is as remarkable as its simplicity; and immediately fell, wounded in the head by the explosion of a shell."

The disasters of Waterloo reopened the road to Paris, to the allied powers; Napoleon's downfall was established, and the Bourbons again took possession of the throne.

One of the earliest measures of the royal government was the disbanding of the troops, upon whose fidelity there was now no dependence to be placed. All the warriors, young and old, were to be seen following the roads to their respective native villages. Bitter were the tears which rolled down their weather-beaten cheeks, as these brave soldiers departed from under the French banners. It was not without a sort of rage that they thought of their emperor's fate; their future prospects destroyed; their dreams of glory vanished. Nothing now remained for them but to return to the paternal plough.

On the 16th of October, 1815, Napoleon, in virtue of the commands of the sovereigns, united in the Holy Alliance, landed at the island of Saint Helena, where his jailers were to be his most implacable enemies,—the English.

By enchaining the hero upon this rock in the midst of the ocean, the traitorous members of the British cabinet knew that they were pronouncing his death-warrant. They wished to inflict a slow torture upon him. Their cruel wish was realized. By the 5th of May, 1821, all was over!

Napoleon, before he died, dictated the following words, words so touching in his condition of a dying exile:—

"I desire that my remains may lie upon the banks of the

Seine, in the midst of the French people whom I have loved so well."

Whilst I am writing these lines, this wish, expressed nearly twenty years ago, is on the point of being put into execution. Moved, no doubt, by one of those Machiavellian afterthoughts which are always so familiar to her, especially with regard to France, the English government has at last decided to set at liberty the illustrious ashes of her glorious victim. Before long the French people will be able to pay a funeral homage to the great man who conquered all the nations of Europe; and, what is no less singular, Napoleon's remains are brought home in triumph by a prince of the royal family of Bourbon!

CHAPTER LII.

THE RESTORATION.

WITH the re-establishment of the Bourbons upon the throne of France commenced a new era of prosperity to our arts and sciences. The peace so ardently longed for after the long and calamitous wars, and now insured to us for some time by the union of all the European powers, caused our old workshops and manufactories to be opened, and many new ones to be built, and excited a spirit of emulation among manufacturers and tradesmen of every description. Circumstances in general, as well as the government itself, acted favourably upon this onward march: circumstances, by the numerous markets opened to French goods in every direction; government, by wise measures suited to the necessities of the times, and, by a judicious distribution of rewards, doing honour to French munificence.

This revival, effected during the restoration, is, notwithstanding the efforts of many to promote a very different opinion, a matter of most undeniable fact.

That learned professor of political economy, M. Blanqué, senior, appears to have formed a just appreciation of the great manufacturing movement which took place at that epoch. "Compare," says he, "France at the present day to what she was twenty years ago, overwhelmed with the weight of her glory and her misfortunes; it is like an entirely new country; it has been sufficient for the hand of man but to touch the surface of the soil, in order to extract from it riches of greater value than any ever produced in the most prosperous days of antiquity. A manufacturing population has sprung up as if by enchantment;

old abbeys and feudal dungeons are transformed into manufactories; bodies of smiths, spinners, and weavers, take the place of the all-consuming, but non-productive troops of soldiers; commerce and the arts open an honourable career to our children under the auspices of peace. A spirit of order and economy spreads through all orders of society; savings banks and insurance offices make poverty the fate of the idle and dissipated alone. The smallest possible sum of money may at once be put out at interest and made productive. The ocean itself has no more irreparable shipwrecks; precautions are taken against the consequences of death. Distances are daily annihilated by steamboats and railroads. The Mediterranean is again a mere lake. The arts and sciences have produced these wonders; and, if France has not the whole merit, her share is yet sufficiently great for her children to feel justly proud of her."

This state of things is no doubt owing to the introduction of the representative form of government into France. The constitutional charter which was solemnly granted to the people by Louis XVIII.; that charter, which was to be the palladium of public liberty, and which proclaimed the legal equality of all citizens, seemed to give new vigour to the nation's somewhat aged blood, and to spread an activity throughout. This activity naturally expended itself upon manufactures.

Attention was particularly drawn to articles of luxury. The fabrication of printing paper began to acquire the high degree of excellence which now distinguishes the products of the manufactories in Paris and the *Haut Rhin*. Bookbinding, mathematical instruments, jewelry, bronze ornaments, cabinet-work, porcelain, plated ware, velvets, satins, embroideries, laces, printed calicoes, cloths, ornamented weapons, hardware goods, &c.; and especially all those things known as *Paris articles*, and exported to all countries, underwent a rapid and important increase, both in the manufacture and sale. Ingenious machines were invented for improving fire-arms, and this branch of industry was carried to a great degree of excellence. The various

ornamental articles of bronze, although much criticized with regard to their execution, acquired a delicacy and a beauty of detail far superior to those of any other nation. Finally, the time was not far off, when the great improvements in lithography rendered this art of great value to France.

Unfortunately, as remarks a skilful political economist, the French consider elegance in every thing to the utter neglect of utility, a point so much regarded in all other countries. Her principal productions, says the same author, are articles of luxury, the very first which we lay aside at the slightest indication of change in the political horizon.

But, during the first ten years of the restoration, tranquillity, both external and internal, was too well established to give rise to any uneasiness. At home, several conspiracies were put down without any serious harm occurring to the government; abroad, the war with Spain, and the expedition into Morea, had by no means the character nor the results of Napoleon's great wars. A most fortunate epoch, then, for arts and manufactures.

There had been no exhibition since the year 1806. Louis XVIII. betrayed the deep interest he took in the progress of the national arts, by commanding one to be held every five years. This enlightened monarch looked upon these exhibitions as an efficacious means of encouragement, and an incontestable advantage, not only as a stimulus to the zeal of manufacturers, and to the hope of rewards, but also as a means of ascertaining which branch of commerce was the most profitable.

In the same spirit, this patriotic king re-established, on the sixteenth of November, 1816, the order of Saint Michael, destined as a reward for the authors of discoveries, works, or enterprises which should be useful to his country. This order, the badge of which consisted of a cross bearing the figure of Saint Michael, and suspended to a black ribbon, had been instituted by Louis XI., on the first of August, 1469. At first it was exclusively military. Mansard and Lenôtre were the first artists who obtained this mark of distinction. In restoring the order

of Saint Michael, Louis XVIII. restricted the number of knights to a hundred.

The king's efforts with regard to the arts and sciences, were ably seconded by a skilful minister. M. Decazes, now grand referendary of the Chamber of Peers, then filled that station. He has been justly termed Louis XVIII.'s *most brilliant minister*. To his wise influence the useful arts owe much. It was he, who, in a great degree, contributed to the re-establishment of the exhibitions of the various products of the arts; it was he who founded councils for the discussion of agricultural, manufacturing, and commercial subjects; and who made the first application of science to the mechanic arts at the *Conservatoire des Àrts et Metiers*. The exhibition in 1819, which was held under his active administration, revealed remarkable improvements in all departments, and especially in those which relate to dress.

The 13th of February of the following year, was a sad day for all France, and particularly for the manufacturing interests. On that day a second Ravaillac murdered one of the heirs of the crown; the regicidal poniard of the fanatic Louvel struck a fatal blow at the Duke de Berri as he was coming out of the opera. He expired a few hours afterwards, in the arms of his uncle the king, asking pardon for the man who had killed him.

In consequence of this tragic and deplorable event, M. Décazes, a prey to the angry accusations of a party now in power, was obliged to resign his important station. This was a misfortune for manufactures, already suffering from the loss of the Duke de Berri, a zealous and intelligent protector of talents and the arts.

Nevertheless, the events which I shall have occasion to mention, and the illustrious names which are about to follow in rapid succession, will prove that our commercial and manufacturing prosperity has increased greatly during twenty-five years. I shall begin this review with an account of several memorable facts in connexion with the alimentary arts.

CHAPTER LIII.

ALIMENTARY ARTS.

A HIGHLY important discovery has gained M. Appert a gold medal. It consists in boiling meat or vegetables, at their precise boiling point, and in enclosing them free from air in tin vessels, which are hermetically sealed. "Enclosed in this manner," says M. Charles Dupin, "food, even at the end of several years, after voyages to the equator and to the poles, will preserve its original freshness, flavour, and smell. Such a preservation of victuals is especially valuable for the navy, which, before this discovery, had no other resource than that of salt food."

The learned gentleman goes on to say, "To preserve food for a length of time, which has a natural tendency to speedy decay, is not only a means of prolonging the enjoyments of the rich beyond the limits imposed by the seasons, or still narrower restrictions, but affords facilities to great numbers for preserving their health, even in situations where many hardships are necessarily endured."

Many thanks are due to M. Darcet, a member of the Academy of Sciences, for having first brought to light the economical method of extracting, in the form of gelatine, an abundant nutritious substance from the bones of animals, which may be used to great advantage in hospitals, in very small families, and particularly in supplying the poor with food. It is also very valuable for barracks, besieged towns, and vessels on long voyages. Gelatinous soup has in this manner been made, in the last few years, in various hospitals and public establishments at Paris. The happy idea of extracting the gelatine from bones

is entirely owing to M. Darcet, junior. He effected this, by separating the gelatinous portion from the saline particles which enter into the composition of bones, by means of muriatic acid, which has the property of destroying the salt without injuring the gelatine.

Chemists have discovered a means of converting organic matter into excellent manure, whence result great advantages to agriculture, which is the basis of all national prosperity. M. Derosne has formed establishments for the desiccation of blood, and thus given to the world a manure also containing the bituminous schist extracted from the mines at Menat. M. Payen has published an account of the remarkable effects of the charcoal-like residuum, which contains a portion of insoluble desiccated blood. This charcoal acts with greater power than an equal weight of liquid blood. This new manure now fertilizes the soil of the west of France, and generally doubles or trebles the produce. Of late, M. Salmon has obtained a new manure of an excellent and economical kind. It consists of a mixture of organic detritus with a mud, which he renders extremely porous and absorbent; he effects this by calcining it in closed vessels, and reducing it to an exceedingly fine powder. In this process, he does not lose a single atom useful as manure. This process was rewarded by the committee on the exhibition of 1834, as very valuable with regard to agriculture, and also to health.

It would be an act of injustice and of ingratitude, to close our account of the alimentary arts without doing homage to the memory of the celebrated Dubauve, who, of late years, by his wise efforts was able to deliver France from the tribute hitherto paid to Italy and Spain for the importation of chocolate; an article, whose virtues have been celebrated by Metastasio in a graceful cantata, and which is so highly recommended by physicians in a number of morbific affections. Sulpicius Dubauve, born at Paris on the 6th of December, 1757, at first studied medicine, but soon abandoned it for pharmacy, which was more in accordance with his naturally mild and sensitive

disposition. Admitted as a pharmacopolist in 1790, he was exclusively occupied with the labours attendant upon his profession until 1800. It was during that period of ten years, and in the midst of the horrors of the revolution, that he discovered the wonderful properties of *Salop,* the prepared root of the *Orchis mascula,* and was the first to apply it to therapeutics. At the same time, Dubauve studied the nature of cacao, and ascertained the various improvements of which it was susceptible, both as agreeable food and as a medicament.

The beginning of the consulate appeared a favourable time for endowing France with the result of his discoveries. He therefore renounced pharmacy in general, and applied himself solely to the making of chocolate. His first attempts were humble, as is always the case with any branch of art destined to prosperity. His first establishment increased rapidly; he soon had others in all the important towns in France. Finally, growing beyond all bounds, Dubauve became a builder, and raised the edifice which still exists in the Rue des Saints Peres, and upholds the renown of its founder.

Guided by his medical and pharmaceutic knowledge, Dubauve entertained the fortunate idea of combining with chocolate various other substances considered beneficial to health. Such combinations acquired a great reputation over all Europe.

We will quote the opinion of Brillat Savarin on this subject; an opinion which does his palate as much honour as his discriminating intelligence.

The following are his own words in his *Physiologie du Gout:*

"Being fond of chocolate, we have tried that of nearly all the different makers, and have at last determined to take no other than that prepared by Dubauve, Rue des Saints Peres, number twenty-six; he is the royal chocolate-maker, and we rejoice that the sun's ray has fallen upon the most worthy.

"It is by no means astonishing: M. Dubauve, a distinguished

pharmacopolist, threw upon the subject of chocolate, new lights acquired by him for purposes of a much wider sphere.

"Those who have not attempted it are utterly unaware of the difficulties to be met with in endeavouring to bring any material to perfection, and how much attention, tact, and experience, are required for preparing a chocolate which is to be sweet without insipidity, firm without harshness, compact without feculency, and aromatic without unwholesomeness.

"Such are the preparations of M. Dubauve; they owe their superior excellence to a choice of good materials, and to a determination that nothing of inferior quality shall issue from his manufactory, as well as to the watchful eye of the master, always presiding over every department of the establishment.

"Agreeably with the rules of his theory, M. Dubauve has sought to offer to his numerous customers preventives against various complaints.

"For instance, for the very thin, he prescribes the *Analeptic Salop chocolate;* for the nervous the *Orange-flower anti-spasmodic chocolate;* for those of irritable temperaments the *Almond-milk chocolate;* to which we must add the *Chocolate for the afflicted,* scented and medicated *secundem artem.*

"Kotzebue, in his *Souvenirs de Paris;* Grimod de la Reynière, in *L'Almanach des Gourmands;* Alibert, in his *Traite de Therapeutique;* Alexis Bombard, in his *Traite des Affections des Voies Digestives;* and the learned Tourlet, in an article in the *Moniteur Universel,* all recommend Dubauve's preparations with the highest praises, and give a celebrity to his establishment, which proves the truth of its motto, taken from Horace, *utile dulci;* a common one, but also one as well suited to it as if it declared in large letters the *renown gained by French chocolate.*"

Dubauve was honoured by the particular esteem of Corvisart, Portal, Alibert, and Montegre, in a word, by that of all the most celebrated medical men. He died on the 12th of April, 1836, leaving a worthy successor in the person of M. A. Gallais,

his nephew, whom he had fortunately taken into partnership in 1823.

M. Gallais is precisely the man the most capable of sustaining his uncle's reputation. Well informed, and possessed of a desire for acquiring further information; endowed like Dubauve with a spirit of research and invention, and alone initiated into the secrets of the combination which had rendered the establishment so justly celebrated, M. Gallais, by himself producing new and happy combinations, has merited the same praise which was so liberally given to his uncle before him. To him alone is owing, among many other inventions of a similar nature, the *Thereobroma.*

M. Gallais has published the result of his researches in a very interesting work entitled *Monography of Cacao,* one volume octavo. It is an entirely new treatise on this subject; it contains a number of curious details, and is remarkable for an elegant and instructive accuracy. The author undertook to spread throughout France an exact knowledge of the useful production which serves as a basis to chocolate; his efforts have been crowned with success.

Finally, in 1835, he discovered an ingenious process for preserving the basis of milk. This is called lactoline, and the discovery would have elevated its author to a distinguished place in the hierarchy of science, if more urgent business had not obliged him to confide it to the hands of others. Lactoline consists of the seminuliferous globules of milk, concentrated by the evaporation of the serum which they contain, and of that which surrounds them. This substance, in order to regain its nutritious qualities and to become milk again, requires only water, of which it has been deprived for the sake of preservation.

CHAPTER LIV.

CABINET-MAKING.

ONE of the branches of French arts which have made such rapid improvements in the last fifty years, is that of cabinet-making. To this art are owing not only magnificent pieces of furniture, but also admirable wainscotings, and ceilings which do honour to the taste of those who have executed them.

Mahogany was much used in this art under the consulate and the empire. At the present day several other woods enjoy an equal reputation for beauty and excellence. Mahogany is the wood of the Indian cashew tree, which grows to the height of our largest oaks. It was unknown in Europe until the beginning of the eighteenth century. "At this epoch," says one of the authors of the *Nouveau Dictionnaire des Origines*, "the brother of the celebrated Dr. Gibbons, commander of a vessel employed in the West India trade, brought back, as ballast, several planks of this wood, which he sent to his brother, the doctor, then building a house in Covent Garden; but the carpenters finding it too hard for their ordinary tools, would make no use of it, and it remained a long time forgotten in the doctor's garden. Some years afterwards, a candle-box was made of some of this wood; but the workman complained, as the carpenters before, of the hardness of the wood, and the weakness of his tools. The doctor advised him to procure stronger ones; and the candle-box was finished. The doctor was so pleased with the beauty of it that he wished to have a desk of the same wood; the workman he employed being very skilful, made it with great taste. Dr. Gibbons, enchanted with his discovery, showed his desk to his friends. The Duchess of Buck-

ingham admired it, and entreated the doctor to give her some mahogany to have one made like it. Thus it was that mahogany was introduced into England, where it was in general use towards the middle of the eighteenth century, and afterwards in all the countries of Europe.

Cabinet-making, towards the end of the revolution, partook of the revival of the fine arts. At that epoch, the celebrated Vien improved the art of painting; and his pupil, David, an excellent artist, and the head of a new school, contributed much to the improvement of taste. A similar metamorphosis took place in furniture, which had hitherto been remarkable for heavy and awkward forms, and strange fantastical ornaments. It was M. Jacob Desmalter who principally contributed to this fortunate change, as much by his advice as his example; and, by the beauty of the articles made under his direction, gained a cosmopolitan reputation.

Born, so to speak, amidst cabinet-ware, for his father was successively cabinet-maker to Louis XV. and Louis XVI., M. Desmalter betrayed, in early youth, a sort of passion for every thing connected with the profession in which he afterwards became so illustrious.

His great labours were undertaken during the consulate. The entire refurnishing of the Château de Saint Cloud, and Malmaison, was confided to him. The bookcase in this latter residence, which was made in two weeks, after a design of Percier, and which is entirely of mahogany, is remarkable for the beautiful execution of all the details, and especially for the skill which triumphed over all the difficulties presented by the place. In this same château M. Desmalter gave new proofs of his talents in the council chamber, the arrangements of which were entirely military, in accordance with the emperor's character. The other apartments of Malmaison were successively fitted up as if by magic. Bonaparte, who saw impossibility in nothing, required the completion of a new piece of work every week, and his orders were punctually obeyed.

Under the empire, M. Desmalter was intrusted with the re-furnishing of the Tuileries, of the Grand and Petit Trianon, the Louvre, the châteaux of Fontainebleau and Compiègne. These different trusts were executed in a manner which did honour to the talents of the artist.

In the palace of the Tuileries the throne room is worthy of great admiration, as well as the emperor's closet, which is ornamented with bronze, and in which there is a mechanical piece of furniture, of curious mechanism, the first of the kind ever fabricated—the empress's sleeping-room, where is a jewel-case, with many secret drawers in the inside. All the architectural portions of this magnificent piece of furniture were of bronze, the rest of various foreign woods; the figures were executed after designs by Chaudet, Lemot, Castellier, and other celebrated artists. At Fontainebleau, we may mention, as particularly worthy of notice, the throne room and the empress's closet. At the Louvre, the gate under the colonnade; it is of bronze and wood, and beautifully executed. In the apartment called *Des Fleuves*, under the tribune of Jean Goujon, M. Jacob Desmalter constructed a door with much art: the ornaments and mouldings are of bronze, and the panels are bas-reliefs imported from Italy, which were originally upon the tomb of King Mausoleus. At Trianon he distinguished himself by the beautiful arrangement of the malachites presented to Napoleon by the Emperor Alexander. They were made into two pieces of furniture, two candelabra, and a vase elevated upon bronze chimæras, in imitation of the antique style.

Besides these pieces of workmanship destined for royal use, Desmalter supplied many of the dignitaries of the court with splendid furniture. He made frequent use of native woods in the fabrication of beds, screens, and various other articles. For instance, walnut, pear and cherry, &c., ornamented with incrustations of wood, and all remarkable for delicacy and good taste.

The execution of a cabinet, for Charles IV., king of Spain, upon Percier's plan, won honourable suffrages for Desmalter.

As may well be imagined, the talents of this skilful artist met with the same encouragement from the Bourbons. The throne room and sleeping-room of Louis XVIII. were the principal pieces of work undertaken at that time.

M. Desmalter's establishment underwent numerous additions under the imperial government, and was entirely beyond the reach of any competition. He carried on all the various departments of cabinet-making, carving, mounting, and gilding, lock-making, and constructing various articles for ships. All the bronze ornaments executed in his workshops, were carved, mounted, and gilded there. When at the height of his prosperity, he employed no less than eight hundred workmen of the above-mentioned trades.

But in modern revolutionary days, it is by no means always advantageous to be under the patronage of a crowned head. M. Desmalter was a sad example of this fact. The overturning of the empire was fatal to his establishment, and caused him to undergo enormous losses. It must also be confessed, that Desmalter, so eminently endowed as an artist, was unfortunately wanting in those qualities so important to every one engaged in trade. Among men exclusively devoted to the fine arts, we often meet with this incompatibility between the warmth of creative genius, and the moderation, the cool calculation so generally useful.

In consequence of these reverses, Desmalter, giving way to his feelings of disgust and disappointment, abandoned the establishment to his son, who not only succeeded in saving it from ruin, but restored it to all its former glory. The father, freed from the restraints of business, went to England, in accordance with an invitation from George IV., who intrusted him with the refurnishing of Windsor Castle. He had made and sent to Rio Janeiro a quantity of splendid furniture for the apartments of Don Pedro, Emperor of Brazil.

His son, mentioned above, M. Jacob Desmalter (George Alphonse), born on the 21st of February, 1799, first studied ar-

chitecture under the skilful direction of Percier. Numerous medals, obtained at the monthly competitions, not only attested his rapid advancement, but predicted a brilliant career, when unfortunate circumstances obliged him to leave this branch of the arts for that in which his father had gained so high a reputation.

The embarrassments we have already mentioned were a severe shock to the Desmalter establishment. With the laudable object of arresting its downward course, the young architect struggled against inconceivable difficulties, and expended much money. He took the complete direction of it on the first of January, 1825, and offered a vigorous and honourable resistance to all opposing circumstances; proving, by his example, that courage, perseverance, and honesty may extricate a man from the most alarming difficulties.

Under the restoration, the Duchess de Berri employed him to furnish the Chateau de Rosny. Afterwards he made furniture, under the direction of M. Fontaine, for the Palais Royal and the Chateau de Neuilly. In this latter residence the ceilings are all of wood-work, ornamented with incrustations.

He also executed all the furniture for the new part of the Hôtel de Ville, as well as the wood-work in the rooms of the *Conseil d'Etat* in the palace on the Quai d'Orsay.

Jacob Desmalter, junior, like his father, obtained the gold medal, offered for excellence in his art, at all the exhibitions. This privilege seems to have belonged to the family since 1806. He is now beyond the reach of the ever varying caprices of fortune. Some of his incrusted furniture is to be compared with the exquisite productions of Boule, the celebrated cabinet-maker in Louis XIV.'s time. Let any one who wishes to be convinced of the taste displayed in Desmalter's furniture, but pay a visit to his establishment, in the Rue des Vinaigriers, Faubourg Saint Martin.

Amongst those who have distinguished themselves in this universally esteemed line, I will mention MM. Werner, Bellangé,

Meynard, and Ficher, who received silver medals, either for beauty of forms or for improvements of construction. M. Meynard has introduced incrustations of copper. M. Ficher has distinguished himself by beautiful ornaments of bronze. It must also be remarked that M. Berg uses copper for ornamenting furniture, with greater success than any one else.

We are now to speak of a branch of art which deserves particular mention. This act of justice is due to the ingenious artist who carried the construction of ship-furniture to a great degree of perfection.

Jean Antoine Lehaene, born at Paris on the 8th of November, 1784, succeeded his father, at an early age, as a cabinet-maker, and continued the old establishment with great success.

In 1814, when commercial relations were renewed between France and the colonies, M. Lehaene made many exportations to India, and various parts of America. Charged, in 1826, by the minister of war, with the execution of models of all the articles necessary for furnishing the vessels of the royal navy, this skilful artist fullfilled the commission with so much accuracy and good taste, that, upon examination, no alterations were deemed necessary in his plan. This success gained for M. Lehaene the post of maker of ship-furniture not only for all our vessels, but also for all our maritime establishments, both at home and abroad.

A fortunate circumstance gave still greater encouragement to M. Lehaene's talents. In 1829, the intendant of the royal furniture, after an exhibition of the articles produced by numerous Parisian artists, intrusted him with the furnishing of the palaces, chateaux, and other royal residences.

But the most difficult, and most remarkable operation performed by M. Lehaene, and the one which has done him the greatest honour, is incontestably the complete fitting up of ten steam-vessels employed for carrying the mails to the different ports of the Mediterranean. In less than a year this vast undertaking was completely realized. All the necessary articles

were made at Paris, and afterwards transferred to the different ports where the packets had been built. The workmanship was so excellent, and the solidity and strength of every part so remarkable, that, during the wear of continual use since 1836, the injuries attendant upon sea-voyages, and the continual variations of temperature, they have experienced no material changes for the worse, and have consequently required no repairs.

An undertaking of so much importance, executed with so much success, has necessarily raised M. Lehaene to the highest rank as an artist. No one can dispute the pre-eminence with him in this branch of art, which he has brought to a new and great degree of perfection.

CHAPTER LV.

IRON.

SIDE by side with the beautiful art of working in wood, stands one which, originating in modern days, threatens soon to rival it, since it lends a valuable assistance to architecture, especially as regards the external decoration of edifices. The reader will readily discern that we speak of the use of iron for ornamental purposes, due to the learned and ingenious researches of a former member of the Polytechnic School, M. Gandillot.

Jean Dénis Gandillot, born at Besançon on the 12th of March, 1797, was one of the most distinguished students in the Polytechnic School, when this establishment was abandoned in 1816. The career which he had chosen was rudely closed before him; his youthful anticipations were destroyed; but, far from being discouraged, his anxiety to rise to eminence of some sort but increased. The mechanical arts, with their vast profits, attracted his attention, and to them did he devote himself. But, leaving the beaten track, and guided by the theoretical knowledge gained during his close attention to study, he opened a path for himself in which no one had yet trodden.

In 1825, he took a high rank as an artist by the establishment of a new art known by the name of *Fers creux lumines*. Among his productions, are to be remarked gratings of every description for balconies, balustrades, and railings, bedsteads of various forms, garden-seats, and furniture, such as stools, chairs, arm-chairs, tables, flower-stands, &c., &c. "And," as remarks M. Charles Dupin, "all these articles are executed with taste and accuracy."

During the first ten years of Gandillot's efforts, the hollow pieces of iron used by him were nothing but tubes made of cast iron when cold, the edges of which touched each other though not welded. For gratings and other purposes requiring strength and solidity, he filled these tubes with a cement similar to that used by fountain-makers. This prevents internal oxidation, and is capable of resisting the action of a saw. For transverse pieces in gratings, he used four-sided pieces of iron, also hollow, and composed of two three-sided bands placed one within the other, so as to form the four faces of the square bar; but the two vertical faces were formed of two thicknesses of iron.

Desirous of giving his art every improvement of which it was susceptible, M. Gandillot made several journeys to England in 1838. It was at that time that he brought into use in France, a method of welding square or round tubes of sheet iron. Welded in this manner, these tubes were substituted for those in former use made of cold sheet iron.

This improvement, all-important as it was, was but the prelude to a still more fortunate innovation, if we consider its results. The principal object of M. Gandillot's researches was the substitution of iron pipes for those of lead and copper, the only kind in previous use in France, and which were extremely inconvenient and often dangerous, whether used for gas, steam, or any of their other numerous purposes.

Thence ensued the use of furnaces of heated water, first introduced by Perkins, but due to the useful and philanthropic efforts of Gandillot. This most advantageous method of heating buildings is in general use in England, not only for public edifices, but also for private houses. Gandillot, after a studious attention to this subject, was convinced of the great superiority of these furnaces over those of France, which gave out heat by means of steam or of heated air. In fact, steam-furnaces are so expensive, that their use is confined to public buildings, such as the Bourse at Paris. As to the heated-air furnaces, besides their enormous consumption of fuel, the vitiation of the atmos-

phere of the rooms, the injury done to furniture and hangings, and the inequality of the heat diffused throughout the same apartment, there is great danger of fire, as was unhappily proved by the recent disaster at the Théâtre Italien at Paris. Thanks to M. Gandillot's improvements, these inconveniences and dangers have disappeared; in their place we have economy, health, and safety, united to an agreeable heat. The pipes made in Gandillot's workshops, and destined for hot water furnaces, are tried before being used, and found capable of resisting the enormous pressure of from two to three hundred atmospheres.

CHAPTER LVI.

BRONZES.

IN the art of fabricating bronzes, such as gave Ravrio so high a reputation, we have now occasion to mention several contemporaneous artists nearly as distinguished as he. First in order of time comes Thomire, who distinguished himself by the richness of his work and the beautiful finish of his execution. "In 1806," says M. Charles Dupin, "he obtained the gold medal, and since that time, has continued, by his remarkable performances, to sustain the character he then acquired. It is glorious to remain in this manner at the head of one's art." These words are taken from the report of the committee upon the exhibition of 1834.

Side by side with M. Thomire, stands M. Denière, who, although he rose to eminence many years later, is no less a great and distinguished artist.

Born at Paris on the 17th of August, 1775, M. Denière left that city as a volunteer in 1795, in one of the three Parisian battalions who were equipped at their own expense. A short time afterwards, he was employed in the fabrication of arms; and was afterwards attached to an establishment of the kind at Paris. In 1796, the government sent him to Constantinople in the capacity of machinist.

Upon his return to Paris, in 1798, we find him working as a journeyman-turner in copper. He afterwards began to work by himself at his lodgings, and collected around him several workmen who placed themselves under his direction. Economy, labour, and perseverance, brought him a rich harvest. In 1804, he was himself able to undertake the making of small bronze ornaments, and in the fourteen succeeding years, his establish-

ment increased, although he experienced considerable losses during the commercial difficulties which attended the downfall of the empire.

At the exhibition of manufactured articles in 1819, M. Denière obtained the silver medal. This was but the prelude to greater triumphs. Four years afterwards, he obtained the gold medal for his beautiful productions, and in the three exhibitions which have been held since, he has constantly received the same honourable distinction; this *maximum* of the rewards offered by the government to the artists.

M. Denière has long been the object of other honours, in consequence of the esteem and consideration attached to his talents. In 1824, he was elected a member of the *Conseil General des Manufactures;* in 1827, Charles X. made him a Knight of the Legion of Honour; finally, from 1833 to 1837, he fulfilled the duties of a judge at the *Tribunal de Commerce de la Seine.*

The works which have established this artist's brilliant reputation are to be admired, not only for their richness, but also for their variety, and still more for the care with which they are executed. During the most prosperous years of the restoration, M. Denière displayed much taste in his tables and other articles of furniture. It was about that time that ornamental pieces of sculpture were made for the dinner-tables of the rich, such as groups of Loves and Graces, Bacchantes and Fauns, and vases in imitation of the finest antique models, as well as baskets borne by elegant canephoræ.

In 1838, M. Denière built a large establishment, embracing, upon an extensive scale, all the various branches of his art, including casting, mounting, turning, carving, and gilding. For ten years he has employed more than three hundred workmen. There was certainly a vast difference between his modest shop, when he first began his career, and his present continually increasing state of prosperity. Such is the reward to which talent may aspire when sustained by good conduct and well-directed efforts.

M. Galle is the most fortunate rival of Thomire and Denière. Like them, he has executed some very remarkable pieces of work; like them, also, he has in his possession a collection of gold medals. Some of his bronze figures are very large and fine; and the exquisite taste of some of his gilded lustres has received great praise.

After these celebrated artists, we may mention various men of talent; among others Ledure and Lerolle, and, as remarkable for taste, M. Jeaunest, who has executed some highly valuable groups of figures, also a Bacchante seated upon a Goat, and a small group representing the Graces, of M. Pradier.

In modern days, an artist who recalls to us the success of the celebrated Balthazar Reller, and his pupil Jacobi, has made great improvements in casting. An important matter in the casting of bronze, is, that the figure to be obtained be perfect, and require nothing beyond being afterwards made smooth by mechanical means. When this is the case, as has wisely been remarked, the artist who is the inventor of the design, finds his idea reproduced with great precision; the somewhat to be mistrusted art of the carver, is no longer indispensable to palliate irreparable defects; and original performances may be obtained at a low price, preserving the beauty and peculiar character of the models.

Such are the results we now owe to the studies and the efforts of M. Soyer. The reader is about to learn how many obstacles opposed this remarkable man in his toilsome road to distinction. May his example serve as encouragement to those young people who are intimidated by the approach of difficulties!

Louis Claude Ferdinand Soyer, born at Paris in 1785, began life as a carver. But, as soon as his apprenticeship was expired, he was seized with a military ardour, and entered a regiment of marine artillery. He soon ascertained that this was not the sphere for the developement of his talents. Instead of the laurels he had hoped to reap, he met with captivity. After five years spent upon the seas, he fell into the hands of

the English, who kept him a prisoner five years longer, giving him full time to reflect upon the vicissitudes of a soldier's life.

The peace of 1814 set him free from his chains; and, returning to Paris, he was about to enter the service of a druggist, for want of better occupation.

Fortunately for the arts, Soyer felt a longing to return to his old art of carving. He had the wisdom and courage to enter upon a second apprenticeship; and, although he had no other means of subsistence than his labour, he was contented to earn but thirty sous a day, and applied himself with the greatest industry, in the hope of becoming a superior workman.

At the expiration of this period of trial, the sanctuary of arts opened its doors to Soyer, or, to speak in plain terms, from being an apprentice he became a master, and so skilful a one, as to exhibit to the public several bronze statues; that of Love after Chaudet, a Jupiter Serapis, and others. These master-pieces gained him the gold medal, and shortly afterwards, in 1822, the government sent him to Italy, free of expense, for the purpose of prosecuting his studies.

After two years spent in this manner, Soyer returned to Paris; but his pecuniary resources were now all exhausted, for, in order to obtain all possible advantage from his sojourn in Italy, he had not hesitated to sacrifice the little he possessed. This augured ill for the art of casting, in a deprivation of the great and important improvements of which he had discovered the secret. Fortunately, Soyer met with a capitalist, who was patriotic enough to endeavour to put the artist's plans into execution. They formed the Ingé and Soyer association, which has given rise to so many improvements in casting during the last ten years. These two gentlemen have certainly not had occasion to regret the generous confidence they placed in each other, at a time when Soyer was poor, and had no security but his word.

To simplify the process of casting, and to reduce the price of

their labours, in a manner previously deemed impossible, were the objects of M. Soyer's successful efforts.

The works which have established his reputation are numerous. The most important at present are the statue of King Stanislaus; the tomb of Count Demidoff, composed of ten figures; the model of Napoleon, now at Versailles; the statues of Fénélon, and Montaigne; of Chevert, of Marshal Mortier, of Ambroise Paré, and of Guttenberg; Piety, and two adoring Angels, in the church of Notre Dame de Lorette; the equestrian statue of Philibert Emmanuel, the admiration of all Paris, placed originally in the great court of the Louvre, but which is at present at Turin; finally, the column of July, with its immense capital, formed in one single casting, notwithstanding that its circumference is eighty-eight feet.

We must also mention the Hercules after Canova, the Magdalene, Michael Angelo's Moses, and figures of animals which required scarcely a touch from the graver and the file, so excellent was the casting.

Services of so high a nature did not remain unrewarded. The Ingé and Soyer establishment obtained the silver medal at the exhibition of 1834, and the gold medal at the exhibition of 1839. In addition, M. Soyer himself received a platina medal and a gold one from the Society for Encouragement, a gold medal from the king of Sardinia, and the badge of the Legion of Honour at the last exhibition.

CHAPTER LVII.

CARPETS—FURNITURE-STUFFS—WALL-PAPER, &c., &c.

CARPET-MAKING, now brought to so great a degree of perfection by Aubusson's establishment, owes important improvements and economical processes to the efforts of the celebrated Chevenard, who, in various other ways, has laid claim to the gratitude of all those interested in the arts.

François Marie Chevenard, the son of François Chevenard, a citizen and manufacturer of Lyons, and Catherine Basset de la Marelle, was born at Lyons, on the 17th of June, 1753, and consecrated his youth to the study of the arts, and especially to that of flower-painting. Devarennes, a painter, his master, took great pride in his pupil's success. The young Chevenard soon painted flowers with remarkable talent. His paintings were much admired; for it could not be otherwise in a city where this style of painting is much in request, on account of its application to silks of high value.

This young artist succeeded his father as a silk manufacturer, in 1780. In his shops stuffs destined for the countries of the Levant were fabricated; and a magnificent collection to serve for furniture for the Grand Seignior, must not be passed over in silence.

Nevertheless, Chevenard did not forget that he was a painter. Lyons possessed no establishment for the painting of wall-paper. He succeeded in founding one, and his talents as an artist soon procured him a high reputation in this department. This establishment having been destroyed, in 1793, at the siege of Lyons, Chevenard, by means of perseverance and labour, raised it from

its ruins, and restored it to its original state, by numerous improvements and inventions, amongst which we must mention the invention of muslin paper, which was imitated over all France and England. The most ancient manufactory in Paris, which had also imitated Chevenard's wall-papers, offered to prosecute all the imitators without putting him to the slightest expense; but Chevenard made a formal refusal to all such offers.

Under the empire, Chevenard established a manufactory of new stuffs in the old Soubise building. These stuffs were a sort of medium between silk and paper hangings. They were extremely well received, and adopted in furnishing the imperial residences, &c. &c. Napoleon paid a visit to this establishment in 1810. He testified to Chevenard all the satisfaction with which he beheld his efforts to extend the dominion of national industry, and promised him, as encouragement, a gratuitous loan of 60,000 francs: this enabled him to extend his manufactory. The restitution of this sum to the treasury was made during the restoration. It was at the time of this visit that Napoleon conceived the project of taking possession of the Soubise buildings, and transferring to them the archives of the country and the imperial printing establishment.

Chevenard took a young relation, Henry Chevenard, into partnership with him. They applied themselves diligently to the discovery of a means for reducing the prices of carpets,—articles at that time only within the reach of the rich. Rewards were offered for such a purpose by the Society for Encouragement. The Chevenards obtained them. M. Charles Dupin speaks as follows on this subject:—

"At the same epoch (1823), a great advance was made, by the Chevenards, in the economical fabrication of the species of carpet called English. These manufacturers obtained the gold medal offered, since 1819, for the production of curtains and hangings of felt, ornamented with silk and woollen, presenting the appearance of richly embroidered stuffs; these are sold at four francs a yard. Other carpets and hangings of varnished

felt are made impervious to dampness by a bituminous composition. This material is susceptible of being beautifully ornamented, and is very serviceable for bathing-rooms, eating-rooms, &c.; still more economical carpets, made of varnished stuff, according to the English fashion, and various others of many kinds. To M. Chevenard are also owing carpets of cow's-hair, sold for from three francs to five and a half the square yard; and finally, carpets of thick velvet, of exquisite beauty, suited to the higher classes."

In 1830, François Marie Chevenard, after sixty years of intermission, resumed his early vocation of a flower-painter, and exhibited several fine pieces of this kind. He died at Paris on the 28th of June, 1835, at the age of eighty-two.

In remaining under the direction of M. Henri Chevenard, this fine establishment for carpets and hangings has increased the importance given it by his predecessor. In 1834, this able manufacturer obtained a renewal of the gold medal decreed to him in 1823, for hangings of varnished felt. He presented at this exhibition several pieces of furniture in the style of the sixteenth century, and even earlier. This furniture of the feudal times has been the object of many criticisms, some of them unjust; but these have not reached M. Chevenard. The romantic style became prevalent, and the arts were obliged to conform to its strange and fantastic tastes. M. Chevenard may be said to have turned its caprices to great advantage.

M. M. Atramblé, Briot, & Co., have done much for this branch of art. In 1827, they exhibited transparent window-blinds, representing Gothic panes of glass and landscapes. From that period great improvements have taken place in these articles, as may be attested by the gold medal obtained by them.

We have already made mention of the great Aubusson establishment. The present is an excellent opportunity for doing justice to the industrious and skilful man who has so greatly contributed to its celebrity.

Charles Jean Sallandrouze de Lamornaix, born at Paris on

thc 27th of March, 1808, was but eighteen when the premature death of his father, the proprietor of the royal carpet factory of Aubusson, caused the whole burden of the establishment to fall upon him. Notwithstanding his extreme youth, Sallandrouze, by his active intelligence, soon showed himself able to sustain the high reputation hitherto enjoyed by his father, who had obtained the silver medal in 1822 and 1823. At the exhibition in 1827, he was equally honoured. Encouraged by his success, he went to England, and brought back a colony of workmen, and naturalized at Aubusson the fabrication of various English stuffs, which, by their low prices, were soon placed within the reach of the middling classes, thus diffusing advantages hitherto confined to the rich.

It was a great matter to have liberated France from the onerous tribute previously paid to England. M. Sallandrouze did more; he succeeded in finding among the English themselves (who are so proud of their manufactures), a market for his splendid carpets, which were very superior to any made in England. Brilliant exhibitions, where were collected all the finest articles of English manufacture of every description, obliged the British to recognise the superiority of our carpets; and at present, the demands of England absorb a great proportion of the products of the Aubusson establishment.

The exhibition of 1834 was an occasion of new triumph to M. Sallandrouze. The following are the words of M. Charles Dupin: "M. Sallandrouze's collection of carpets were, without comparison, the finest, richest, and most varied, to be seen at the exhibition; covering and ornamenting the entire walls and floor of an immense room, arranged expressly for the reception of these magnificent stuffs.

"The most sumptuous kind was represented by the large carpet destined for the new gallery in the Palace of the Tuileries. In this carpet, beauty of design, fineness of texture, and splendour of colouring and shading, dispute the palm.

"Amongst those of inferior quality, were remarked Scotch

carpets, having no wrong side, another kind called *Moguettes*, hearth-rugs, table-covers representing beautiful landscapes, and oil-cloths for summer use. All these are of various kinds and prices, down to the cheapest, and consequently the most useful."

A late and beautiful introduction is that of Persian and Turkish designs upon carpets. The former are particularly remarkable for elegance and grace.

The committee rewarded the author of these magnificent productions by the gold medal; and the king made him a Knight of the Legion of Honour.

This continued success elevated M. Sallandrouze to a high place in the public esteem. He was made President of the Aubusson Consulting Council of Arts and Manufactures, a member of the General Council of Manufactures and Commerce, and finally, in 1839, a member of the central committee for deciding upon the merits of articles exhibited, and giving rewards. He attained the summit of his career at an age when others are struggling with the difficulties always attendant upon the first steps of the road to distinction.

M. Sallandrouze, having been made reporter to the committee on patents, published some very judicious opinions upon the laws which govern that subject. Many collections have reason to thank him for excellent articles, in which he has treated of manufacturing subjects of the highest interest, with a knowledge and an accuracy which render these papers extremely valuable. In practice, as well as in theory, the illustrious manufacturer of Aubusson unites claims which may one day call him to sit in the Chamber of Peers.

Among the manufacturers who have the most contributed to the improvement of carpets, with the object of placing them within the reach of those of moderate fortune, we will mention Rogier, Jobert Lucas and Louis Ternaux, Rose-Abraham and Armonville, as well as the Brunet brothers. All these have more or less reduced the prices of carpets by simplifying their fabrication.

CHAPTER LVIII.

ORNAMENTAL ARTS, WOOLLEN STUFFS, &c.

M CHARLES DUPIN has not omitted to remark that the restoration was a most flourishing epoch for those arts which tended to ornament churches, from the making of the simple stole to the construction of the bishop's mitre; the lawn sleeves to the cope and chasuble. These were originally remarkable for splendour alone; they have since become distinguished for taste.

In fact, all the arts, which had in any manner reference to clothing of any description, progressed in a very rapid degree, after the return of the Bourbon family to the throne of France. Many names became distinguished or worthy to be so; and we shall mention a few of those which rose to the greatest eminence.

At the head of our proprietors of spinning-mills, we shall place Eugene Griolet, who has made great improvements in the spinning of carded wool, and who alone employs about fifteen hundred workmen.

For the weaving of fulled and figured woollens, we must mention Terneaux, senior, of whom we have spoken in a former part of our work; Cunin Gridaine, who ranks high as a manufacturer in Sedan, and has obtained several gold medals, and fulfilled the functions of a member of the central committee on the exhibitions of manufactured articles, and been called to the important duties of the *Ministere du Commerce;* Frederic Jourdain and Riboulleau, manufacturers at Louviers; Bacot, father and son, at Sedan; Louis Robert Flavigny and son, at Elbeuf; Guibal Anne Veaute, at Castres; the Chayaux brothers, at Sedan; Dannet, father and sons, and the Aubé brothers

and Co., at Beaumont le Roger, in the department of L'Eure; Berteche Lambquin and son, at Sedan; Chefdrue and Chauvreulx, at Elbeuf; Victor and Auguste Grandin, also at Elbeuf; Lemaire and Randoing, at Abbeville; and lastly, Julien, Guibal junior, and Co., at Castres. All these manufacturers have obtained the gold medal, some of them more than once; several have been honoured with the badge of the Legion of Honour, in reward for their labours, and for the improvements introduced by them into their branch of art.

For another description of woollen stuffs, the manufacturing establishment of Paturle, Lupin and Co. is especially distinguished. Their goods are exported to the Netherlands, England, Italy, and America, where they sustain the reputation of their able manufacturers. It is a well-known fact that the head of this establishment, after receiving several gold medals, and taking his place in the committee so often mentioned, enjoys at the present day the honour of a seat in the Chamber of Peers.

Next in rank are Eggly, Roux and Co., whose goods unite strength to beauty; Griolet, already mentioned as the proprietor of spinning-mills; and especially Rey, who has evinced so much talent in his combinations of silk and wool, whence result the beautiful and varied materials known by the names of Pondicherry, Sumatra, Golconda, &c.

I will also cite Louis Aubert, of Rouen, for woven stuffs of plain woollen; the Henriots, of Reims, for stuffs lightly filled and not figured; Fourninal, father and son, of Rethel, for merinos. If I were to continue the list of all those who have won bronze and silver medals, it would soon extend beyond our limits.

In the art of dyeing threads and stuffs, the highest honours belong to the unfortunate Beauvisage, who produced a beautiful scarlet with lake-lake; to Gonin, of Lyons, who used madder alone; to Raymond, who discovered the secret of substituting Prussian blue for indigo.

Many improvements have been made in colouring silk by

three of Roard's pupils—Perdreau, of Tours, Renard and Brunel, of Avignon. Widmer of Jouy, has discovered a fine green, with which he colours cotton stuffs, without a successive application of yellow and blue. The English offered a reward of 50,000 francs for a similar discovery. More recently, Guymet, guided by a knowledge of chemistry, has succeeded in producing by artificial means the substance called ultramarine; one formerly more valuable than gold, and of as fine a quality as that formerly extracted grain by grain from lapis lazuli with great difficulty; and what adds greatly to the value of the discovery is, that the new and abundant ultramarine is two hundred times cheaper than the old.

As we mentioned before, the arts which relate to clothing were in a flourishing condition during the restoration, on account of the splendour required for sacerdotal vestments, and various ornamental articles for churches. The magnificence displayed at the coronation of Charles X. was a proof of this, and of the manufacturing treasures France had accumulated during the calm of peace.

The Koechlin family, so celebrated in the art of printing goods, have evinced the same activity in continuing as in creating it. It was Daniel Koechlin who discovered the chemical agents capable of acting upon Turkey red. The glory of having solved this important problem, gained him the homage of our neighbours the English.

"After the peace of 1814," says M. Charles Dupin, "this celebrated manufacturer visited England. The entrance to a manufactory of printed cottons was refused him; he sent a small pattern of one of his own pieces of goods to the proprietor, who, filled with admiration, opened his doors to Daniel Koechlin, astonished that any one who was the author of a similar master-piece, should come to England to gain information."

Besides Daniel Koechlin, the art of cotton-printing claims several other members of this honourable family: the Koechlin brothers, Grosjean Koechlin, Schlumberger, Koechlin and Co., all

established at Mulhausen, and all in the habit of receiving gold medals at the exhibitions. Their reputation is spread over all the world. Numerous similar establishments were formed in all places. Gros, Odier, Roman and Co., whose manufactory is established at Wesserling (Haut Rhin), executed all the transformations of cotton with rare excellence, and deserve to rank highest, as well for the design, colouring, and delicacy of the prints, as for the excellence of the material. Dolfus Mieg and Co., at Mulhausen, are not less distinguished for skill, and the extent of their commercial operations. The Hausman brothers, of Ingelbach (Haut Rhin), were the first who applied lithographic engraving to making impressions upon cotton, woollen, and silk, a method uniting beauty to cheapness. They also excelled in the use of the double roller. Hartmann, father and son, of Munster, obtained superior results in every species of printing; and excel, also, in the simple kind, in which they display a taste and beauty of execution which leave nothing to be desired. Adrien Japuis, a pupil of Oberkampf, is the founder of the Clay establishment (Sèine et Marne); by incessantly renewed efforts, efforts continued by his children, he has succeeded in obtaining results which do honour to the nation. It would be unjust to omit to mention Hailmann and Hofer, of Mulhausen, who, since 1819, have obtained the gold medal, as well as the Koechlins and Dolfus Mieg.

CHAPTER LIX.

CASHMERE SHAWLS, &c.

THE spinning of the cashmere down is a fortunate innovation which has enabled this material to vie with the various new stuffs obtained by the mixture of woollen and silk. Hindenlang deserves to be considered as the founder of this new branch of art, which now occupies millions of workmen. He was the first who established this sort of spinning, and produced, in 1813, the first cashmere threads suitable for being woven into shawls.

M. Joseph Ulric Hindenlang, the eldest of his family, was born at Bâsle, in Switzerland, in April, 1795, and began his manufacturing career at an early age: since, in 1813, we find him already superintending the spinning of the cashmere down. This branch of trade, brought to a great degree of perfection at the present day, is a source of great wealth to the country, and owes its rapid progress to the constant efforts of Hindenlang. Ambitious to ameliorate the condition of his productions, he eluded no difficulty (and he encountered numerous ones), he avoided no sacrifice to bring it to perfection.

Since the exhibition of 1819, where he obtained the silver medal, Hindenlang has always been the object of the committee's highest approbation. In 1823, the gold medal was decreed to him, and he was, besides, made a member of the General Council of Mannfactures, and a knight of the Legion of Honour. At the exhibitions of 1827 and of 1834, Hindenlang again took the gold medal, an honour which was confirmed to him in 1839, not only for the spinning of cashmere down, but also for that of merino wool—a branch which he united to his former one in 1836, and in which he has made such improvements, that at the last exhibition he presented merino threads of

a fineness previously unknown. These extra fine merino threads, which no one had yet undertaken to spin, have become of general use since that epoch, and have given birth to a number of novel articles, the fabrication of which was impossible with the woollen threads in former use. This remarkable innovation was an important service rendered to the trade in woollen goods. The committee appreciated it; and the government, eager to notice the useful labours of Hindenlang, conferred upon him the grade of officer of the Legion of Honour, at the close of the exhibition.

In modern days, M. Lemare has gained a high reputation by the constancy with which he has devoted himself to the art of making ingenious and economical apparatus. Every one is acquainted with his cooking apparatus, which has been so often imitated.

Towards the end of the year 1820, he made public some new cooking-vessels called *autoclaves*. This invention is, in fact, no other than *Papin's vessel* applied to domestic purposes, and especially to the cooking of food. The autoclave vessels have the advantage of making good soup, and of cooking meat in less than half an hour. But this apparatus requires great caution. It has been the cause of terrible accidents. Who does not remember the tragic death of the singer Naldi? This artist, having procured an autoclave vessel, wished to put it to proof in presence of several of his friends. Whilst the guests were awaiting the result of his experiment, the vessel exploded, and spread terror among the beholders. Several were wounded; Naldi was killed on the spot.

Lemare has three times obtained the silver medal at the exhibitions. In 1834, the committee made honourable mention of an invention of his for baking bread.

The stoves and culinary utensils of M. Harel are of great use in domestic economy; they are much sought after by housekeepers. Their inventor received the silver medal at every exhibition since that of 1819.

Lerebours.

CHAPTER LX.

HOROLOGY—OPTICAL INSTRUMENTS, &c.

HOROLOGY, in its different branches, is now about to offer to our view numerous celebrated artists, many of whom possess hereditary talents, and have met with hereditary honours.

In nautical and astronomical horology, we have M. Bréguet, the nephew who carries on his uncle's studies with great success, and retains the gold medal in the family; the Berthond brothers, whose chronometer has excited the admiration of the learned men of the Paris Observatory; Percelet, father and son, to whom is owing the counter so valuable for measuring the precise duration of astronomical phenomena,

and admirably executed apparatus for the demonstration of the most remarkable escapements. M. Motel, marine chronometer maker, is well known for the excellent execution and extreme regularity of his instruments.

For horological mechanism on a large scale, the Lepaute family hold the highest rank. To M. Lepaute, junior, the city of Paris owes the fine clock in the Palace of the Bourse. That in the Compiègne Palace is also his work, and he is also the author of the clock in L'Hotel des Portes, where he has overcome great local difficulties.

We must also mention M. Wagner (Henri Bernard), who, among other remarkable pieces of mechanism, has constructed three fine clocks.

In domestic horology, such as relates to timepieces and common clocks, M. Pons de Paul is especially distinguished, and has received two silver medals, and three of gold. He is also the author of numerous works for watches, executed with great precision. He presented, in 1834, a new escapement, remarkable for its great simplicity, being somewhat similar to Woet's wheel-work in theory.

After him come Garmier, Deshays, Vincenti, Hanriot, and Robert, who excel in the various kinds of clock-making.

It is impossible to cite all those who are distinguished in this learned and ingenious branch of science. The Encyclopedia indicates several, under the article *Watch*, which treats of the different branches of horology; mentioning M. Brocot, of Paris, as always occupied in improving his clocks by new and important processes, so that without a proportionate increase of price, we have great ameliorations in pendulums, &c.

As to watches, none are able to compete with those of the Japy family, whose immense establishment, founded in 1780, is situated at Beaucourt, a village in Béfort (Haut Rhin). It embraces all the departments of house-clock, watch, pendulum, and lamp-making, as well as lock-making, hardware-making, and the construction of kitchen utensils, &c. More than six thou-

sand persons, of all ages, are employed in this, as it were, collection of manufactories. The following is an account of the origin of it:—

Frederic Japy, the son of a skilful village blacksmith, went to Switzerland at an early age to study watch-making, with a distinguished watch-maker named Perrelet. Returning to Beaucourt after an apprenticeship of eighteen months, he continued to work there for his master. Having great fondness for his profession, combined with uncommon industry, he soon found himself at the head of several apprentices, and established at his father's house a little body of watch-makers. But the daily increasing number of his workmen outgrew the limits of this small dwelling, and he left Beaucourt accompanied by them all, to establish himself at Montbéliard. Not being a citizen of this place, public jealousy was on the alert to speak ill of him, as is so often the case. Frederic Japy resolved to leave this place; and returning to Beaucourt, succeeded, by dint of labour and economy, in constructing a building of sufficient size to contain all his workmen, as well as his sixteen children.

The necessity for providing for so large a family obliged him to bring all his energies into play. He invented various improvements in watches, and for these he had a good sale at Neufchâtel, in Switzerland. His establishment soon became known; he enlarged it in proportion to his increasing profits. Finally, in 1806, after obtaining honourable mention at the exhibition, Frederic Japy retired from business with a considerable fortune, leaving his establishment to his sons, who are now the proprietors, under the firm of Japy brothers.

Frederic Guillaume Japy, eldest son of the founder of the Japy establishment, is at present the head of the family. The necessity for liberating themselves from the enormous debt contracted with their co-heirs, inspired them with the idea of increasing their establishment, and carrying to a still more extended degree their improvements in watches, as well as

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uniting to this branch of industry those of clock-making, lock-making, hardware, &c. &c., as mentioned before.

Their situation at Beaucourt becoming too circumscribed for the exercise of so many branches of art, they removed to the department of Doubs, a short distance, and there established four successive factories. Hardly had they taken possession of the new establishments, when the allied armies a second time invaded France (1815). At the instigation of those who were inimical to the establishment, these foreign troops not only destroyed all the machinery belonging to the Japy brothers, but set fire to the various buildings and burnt them to the ground. The loss was estimated at 1,800,000 francs. Fortunately, the new factories at Doubs were not involved in this disaster, and the Japy family, enjoying a solid reputation for loyalty, had no difficulty in finding capital. In the space of eight months, Beaucourt arose from its ruins, as if by magic. Since then, its prosperity has not ceased to increase. The various branches of art there carried on, contribute in a great degree to the well-being of the country, since the inhabitants of all the neighbouring villages, including a circuit of from two to four leagues. The wages of the labourers vary according to their capacity, intelligence, and skill, from five sous to five francs. The Japy brothers are now able to sell a wheel-work for two francs, and even at one franc five sous, which, before the introduction of their valuable improvements, could not be had for less than seven francs.

The Japy brothers obtain the highest reward at every exhibition. M. Charles Dupin said of them in 1834, "These distinguished manufacturers, already mentioned as having gained the highest rewards for their utensils, hardware, &c., may number their establishment among those which do honour to France, and, by the various improvements introduced by them, have undoubted claims to the gold medal."

If science renders eminent services to art, art is often of great importance to science. How limited and uncertain would be

the astronomer's observations, if he were deprived of the instruments invented and improved by the optician's art! How from the height of his observatory could he follow the course of a comet, and announce its re-appearance, if his eyes were not powerfully seconded by the excellent glasses, by means of which the heavens are penetrated?

This art is well adapted to show the great degree of union existing between science and art.

Although England and Germany possess many men who are distinguished for the construction of astronomical instruments, this branch of optics has made so much progress among us in the last half century, that the supremacy here belongs to France, as it does in so many other arts.

If the Germans are proud of their Schroeter, Fraunhofer, and Mertz; the English of Herschel, of Troughton, the skilful constructor of numerous instruments for the Greenwich Observatory, of the ingenious Dollard, the inventor of the combination of lenses composed of two kinds of glass, namely, flint glass and crown glass; certainly, France can compete with them in the list of illustrious names which dread no comparison.

For instance, have we not Fortin? who has ably seconded the labours of the most illustrious men of learning, to whom we owe the execution of the improved heliostat, and the great mural arch which the Duke d'Angoulême presented to the Paris Observatory. M. Fortin received the gold medal at the exhibitions of 1829 and 1833.

We have also M. Cauxchoix, whose success, according to the reporter of the committee of 1834, has surpassed all that has ever been expected of the most skilful European opticians. He has furnished excellent telescopes for the observatories at Strasbourg, Geneva, Rome, and Brussels, as well as for Ireland, Spain, Egypt, and four scientific establishments in the United States. It was M. Cauxchoix who constructed the largest known objectives. His great telescope is considered equal in power to that of Sir John Herschel, but superior in some other

respects. By the invention of new methods for executing similar instruments, M. Cauxchoix has rendered eminent services to astronomy and working in glass. He has obtained the gold medal at every exhibition since 1823.

An equally illustrious contemporaneous artist is the celebrated Lerebours, optician to the Observatory of Paris, and nautical instrument maker, as well as a member of the *Bureau des Longitudes*.

Noel Jean Lerebours was born at Mortain, on the 25th of December, 1764, and was sent to Paris in his childhood to serve an apprenticeship to instrument-making. By no means the favourites of fortune, his parents had been able to give him but a slender education; but his amiability, his orderly habits, and extreme industry, soon opened the way to future distinction.

At the age of twenty, Lerebours worked in his own room; with the money he had saved he purchased tools, and five years later founded an establishment which prospered from year to year, by dint of labour and study, combined with many and repeated sacrifices. During ten years of his life, he made a practice of devoting three nights in the week to collecting information respecting his art; this assiduity soon repaired the defects of his early education.

At the time of the revolutionary troubles, Lerebours had already acquired a great name by the care with which he constructed optical instruments. Under the empire, he stood in the foremost rank among artists of his profession. In 1804, Napoleon, intending to go to the camp at Boulogne, expressed to the astronomer Delambre a strong desire to possess a good telescope. "Sire," said this learned man, "we can give you a Dollard telescope, which we have in use, and your majesty would oblige astronomers if you would give us in exchange an excellent five-inch glass which M. Lerebours has just completed." "Is it better?" "Yes, sire." "Then I will take it myself."

In 1812, Lerebours submitted to the inspection of the Academy some mirrors for reflecting telescopes, and a number of

object-glasses of from 97° to 102° diameter. The mirrors, upon examination, were found worthy to compete with the best ever made in England. "What we principally admired," says Delambre in his report, "was the accuracy with which his instruments were made; in this respect, we cannot praise M. Lerebours too highly, for his object-glasses are perfectly achromatic, and show the edges of objects with a clearness which cannot fail to give entire satisfaction."

Lerebours finished, in 1816, a telescope whose speculum was 19° in diameter. It was at this time, the largest and best refractor in the world. This instrument was afterwards purchased by the *Bureau des Longitudes;* it met with the approbation of the Academy of Sciences. Louis XVIII. ordered a telescope for the Observatory at Paris, of 0^{m} 240 in diameter, and of only 3^{m} 32 focus. Lerebours finished this instrument in 1823. The celebrated Herschel, speaking of a star observed by him in 1825, wrote as follows: "I know of but one dioptric telescope by means of which this star has been seen double; that is Lerebours', now in the Observatory at Paris, and the object-glass of which, like that of Dorpat, is nine inches in diameter, eight and a half of which are used."

Lerebours took his son into partnership with him for the construction of these admirable instruments. In 1829, a trial was made at the observatory of one of their telescopes, with an object-glass of 0^{m} 33 in diameter. These labours, and others of the same nature, obtained the suffrages of all who were competent judges; and no one will be surprised to hear that they have constantly won the gold medal at the exhibitions since 1823.

Lerebours has been one of those eminent artists who have raised France to a level with England in the execution of achromatic telescopes.

"Let us listen," said M. Charles Dupin in 1834, "to the judge-delegates of the Academy of Sciences, in the expression of their opinion respecting Lerebours' instruments:

"In the use of telescopes of thirty-nine centimetres, we have often observed the obscure and almost imperceptible line which indicates that Saturn's ring is double; and nevertheless the planet was but a short distance above the horizon. . . . . The observations made upon Jupiter have proved that, with respect to achromatism, Lerebours has advanced as far as is possible. Among his object-glasses, there are some which magnify Jupiter four hundred times, without the slightest trace of the primary colours. This gives them a decided superiority over the generality of telescopes of similar dimensions, hitherto constructed." . . . . "After the above-mentioned instruments," continue the members of the Academy, "we remain persuaded that no French astronomer need feel a necessity or a desire for a foreign telescope. A merely good telescope only attests excellence of materials and a skilful maker; but, when we behold so great a number of object-glasses, all fashioned by the same hand, it is impossible to refuse our consent to the opinion that it is to his care and skill, to his improvements, and his experience, that the artist owes so brilliant and lasting a success."

"Having done so much, it is difficult to understand how an artist can do more, or having done so well, to continue to do so well," says M. Charles Dupin.

Lerebours made great sacrifices in order to introduce the fabrication of flint glass into France, and especially to obtain it of superior quality. He sought fame rather than riches. He died on the 13th of February, 1840, deeply regretted by all who had been acquainted with the noble qualities of his heart, and the modest simplicity of his character. He was a Knight of the Legion of Honour, a member of the General Council of Manufactures, and of the Society for Encouragement.

Of late days, a young instrument-maker has outstripped all competitors. This is M. Gambey, now a distinguished member of the Academy of Sciences.

Henri Prudence Gambey, born at Troyes, in Champagne, established his first claims to notice by a machine for graduating

astronomical instruments; by means of this machine, all sorts of circles may be divided with the greatest accuracy, without the assistance of the human mind. A mechanism placed in an adjoining room executes, by means of a wheel which it turns, the graduation of any circle whatever; by means of an apparatus of his invention, the circle to be divided may be placed out of the centre without causing the slightest eccentricity of graduation. Formerly, this eccentricity had always existed, to the despair of the artist interested in this subject so important to astronomy. M. Gambey has also invented a repeating theodolite with two circles, the one vertical, the other horizontal. The vertical circle is placed eccentrically, as well as the telescope, which serves to measure the angles; but by a peculiar contrivance, the horizontal angles, although measured at the circumference of the circle, are submitted to a measurement exactly similar to that produced by performing the process in the centre of the instrument, and are at the same time corrected of all the errors arising from a faulty rectification of the different parts of the instrument.

At the exhibitions of 1819, 1823, 1827, and 1831, M. Gambey presented various instruments which met with the approbation of the committee, especially a heliostat, and a compass of his invention.

The learned reporter to the committee of 1834, after speaking of Lenoir, Jecker, and Fortin, and some other skilful instrument-makers, says:

"A still younger artist has risen above all his predecessors. For the first time, M. Gambey displayed his instruments at the exhibition of 1819; he takes the highest rank by the astonishing execution of his repeating circles, and various other philosophical and mathematical instruments. In 1827, he surpassed himself by a heliostat of a learned composition, and by a meridian telescope provided with a declination circle. Let us also mention his magnificent equatorial, the action of which is much admired for its perfect regularity. In this instrument, the polar

axis is moved by a peculiar kind of clock machinery adjusted to sidereal time."

Such is the perfection now obtained by this eminent artist, that in his small theodolites, circles having a circumference of nearly eight centimetres, are graduated so regularly and so neatly that the observer may read with precision by means of a vernier arc of five seconds! These accurate instruments are placed within the reach of men of moderate fortune; at the same time, their lightness, and small size, render them easy of transportation in military expeditions, scientific voyages, and geodœtical operations, even in mountainous countries.

Fifty years ago, all Europe had recourse to England for astronomical instruments of this kind; now France supplies the more advanced nations, and even England herself.

In the early ages, when the art of measuring angles was in its infancy, instruments of enormous size were used. Such was the Osymandias circle, with which the Egyptian priests observed the progress of the stars. Such a circle, of very great diameter, was very inferior in precision to those of M. Gambey, the circumference of which does not exceed the breadth of a man's hand.

Works of so important a nature merited magnificent rewards. After having obtained three gold medals at the exhibitions, M. Gambey was made a member of the Institute, a Knight of the Legion of Honour, and of the order of Leopold of Belgium, a member of the *Bureau des Longitudes*, and of various learned societies.

CHAPTER LXI.

AMERICAN MECHANICS AND THEIR INVENTIONS.

ELI WHITNEY, the inventor of the cotton gin, was born December 8, 1765, in Westborough, Worcester County, Mass. He gave early indications of the mechanical genius which afterwards rendered him remarkable. During the Revolutionary war, and when but fifteen or sixteen years of age, he suggested to his father a plan for making nails, an article which then commanded a high price. His father having procured for him a few tools, he entered upon his labour with much spirit; and though working alone, he was soon enabled to set up a small manufactory whose profits amply repaid his enterprising labours.

In 1789, after having struggled through many difficulties, he entered Yale College. It was soon after taking his degree, in 1792, that he conceived the germ of that discovery which subsequently rendered his name illustrious. He was then employed at Savannah, in making a kind of frame-work called tambour, in the family of Mrs. Greene, wife of General Greene. On one occasion this lady

introduced him to a party of visitors, principally officers of the army, who in social conversation had been regretting the tediousness of the process by which at that time cotton staple was separated from the seed. Then men, women, children and slaves were accustomed to meet in the evening and *pick* the cotton. The separation of one pound was, by this process, the day's work of a woman. Mrs. Greene introduced her young friend to the company as one who could make any thing. The result proved that her esteem was not misplaced. Although, previous to this, Whitney had never seen cotton seed, yet he at once entered upon the task which this interview suggested to him. He was furnished with a room to work in, by a Mr. Miller, to whom he had communicated his designs; and here, under the disadvantage of being obliged to manufacture his own tools, and draw his wire, he was now in an occupation befitting his genius; and the zeal with which he devoted himself to it excited the curiosity of all his acquaintances. On May 29, 1793, Miller entered with him into partnership, agreeing to furnish the funds requisite to the undertaking, on condition that "the profits and advantages arising therefrom, as well as all privileges and emoluments to be derived from patenting, making, vending and working the same, should be mutually and equally shared between them." Before the close of the year the machine was nearly completed.

But Whitney was not permitted to enjoy uninterruptedly the reward of his persevering labours. The people soon became apprised of his invention, and so intense was the excitement caused by it, that a party broke into his room by night and carried off the machine. Not having secured his patent, Whitney had the mortification to behold machines constructed on his own plan going into operation in every important cotton district of the State. Then began that long and vexatious dispute, whose object was to wrest from the laborious mechanic the fruits of his exertions, and which rendered his life, during many years, a condition of turmoil, anxiety, and disappointment. Our limits will not admit an account of these, nor of the numerous lawsuits to which he was subjected, nor the

vast expense which he incurred in efforts to establish his legitimate claims. Few men could have sustained the fatigue and privations he underwent, or borne up under his complicated vexations. Sometimes his health was seriously affected, at others his life was jeopardized. Before the final decision in favour of his patent was obtained, the term of his right had nearly expired; and it is affirmed that "more than sixty suits had been instituted in Georgia, before a single decision on the merits of his case was obtained." On one occasion, (March, 1795,) his shop, with all its machines and papers, was consumed by fire; at another, the sale of his patents was so low that it would not defray the expenses of an agent. The manufacturers of England condemned the gin on account of its *greatly injuring the cotton.* The first suit at law (1797) was, in face of the clearest evidence, decided against him. Efforts to obtain a new trial failed. The legislature of South Carolina, after negotiating for a purchase of his patent, suddenly annulled the contract, and sued the two patentees for the money already paid them. The legislature of Georgia pursued a similar policy—though it should be added that both States subsequently rescinded these unjust acts, and permitted a too tardy justice to be extended to the inventor. On December 7, 1803, Mr. Miller, Whitney's generous and enterprising friend and fellow-patentee, died. A gentleman who sometimes acted as his legal adviser affirms that never, in all his experience of law, did he see a case of such perseverance under such persecution; "nor do I believe," he adds, "that I ever knew any other man who would have met them with equal coolness and firmness, or who would finally have obtained even the partial success which he had. Even now, after thirty years, my head aches to recollect his narratives of new trials, fresh disappointments and accumulated wrongs."

In 1798, impressed with the uncertainty of all his hopes concerning the cotton gin, he entered upon a new enterprise, the manufacture of arms for the United States. With this object in view, he purchased a site for his works, at East Rock, a precipice near New Haven. As customary with him, he invented his own machinery,

and applied it to the improving of the art of manufacturing guns. Soon after, the tide of fortune began to turn. Besides obtaining large receipts from the Carolinian legislatures, he gained, in December, 1807, a most important suit against a trespasser named Fort. Judge Johnson, in his decision upon this case, thus characterizes the influence of Whitney's machine upon the manufacturing and agricultural prospects of Georgia. "With regard to the utility of this discovery, [which had been called in question by Fort,] the court would deem it a waste of time to dwell long upon this topic. Is there a man who hears us, who has not experienced its utility? The whole interior of the Southern States was languishing, and its inhabitants emigrating for want of some object to engage their attention and employ their industry, when the invention of this machine at once opened views to them which set the whole country in active motion. From childhood to age it has presented to us a lucrative employment. Individuals who were depressed in poverty and sunk in idleness have suddenly risen to wealth and respectability. Our debts have been paid off; our capitals have increased, and our lands trebled themselves in value. We cannot express the weight of the obligation which the country owes to this invention. The extent of it cannot now be seen. Some faint presentiment may be formed from the reflection that cotton is rapidly supplanting wool, flax, silk, and even furs, in manufactures, and may one day profitably supply the use of specie in our East India trade."

At the next session of the United States Court, Mr. Whitney recovered damages to the amount of thirty-five hundred dollars. Soon after, the term of his patent-right expired. He then devoted himself almost exclusively to some improvements in the manner of manufacturing muskets, in which he was so successful as soon to see his method obtain precedence in every considerable armory of the United States. The value of these improvements may be estimated from the fact that, in 1822, the U. S. Secretary of War, Mr. Calhoun, admitted that the government was saving, by his

alterations, twenty-five thousand dollars per annum at but two public armories.

In 1812 Whitney applied to Congress for a renewal of his patent, but was unsuccessful. In January, 1817, he married Miss Henrietta F. Edwards, daughter of Hon. Pierpont Edwards of the District Court of Connecticut. His death took place January 8, 1825.

Mr. Whitney seems to have been endowed with all those qualities, which render existence a source of enjoyment both to the individual and the community. With a high sense of honour, and of the sacredness of friendship, with a perseverance in the attainment of useful objects, and temperance in their use, and with a strength of will that could keep in subjection feelings naturally strong, he was enabled so to exercise his exquisitely mechanical genius, that he attained a lasting hold as well upon the admiration and gratitude of his country as upon the esteem of his personal friends. In the language of an eminent scholar, when speaking of his monument, "his simple name would have been epitaph enough, with the addition perhaps of 'the inventor of the cotton gin.'"

A man who in genius, in perseverance, and in misfortune, may sustain a parallel with Whitney, was JOHN FITCH, one of the most distinguished of our early mechanics who turned their attention to the consideration of steam as a propeller of vessels. Notwithstanding his many labours he was subjected, like Columbus, to see them eclipsed by those of a subsequent adventurer in the same tract. It is believed by many that the plan of applying steam to the above-mentioned purpose, was conceived by several, in different countries, in the sixteenth century; but the honour of the first actually successful experiment of this kind appears, from substantial evidence, to be due to John Fitch.

Fitch was born, January 21, 1743, (old style,) near Windsor, Conn. In a memoir which he bequeathed to the Franklin Library Company of Philadelphia, is contained an account of his early life, with a history of his experiments on steam. His father was a farmer in good circumstances, a strict Presbyterian, and somewha

stern in the enforcement of family duties. With regard to every thing else, he appears to have been more liberal. Before his twelfth year Fitch made little progress in intellectual knowledge, either at school or at home; but some signs of a taste for mathematics were much earlier visible. He studied what few books he could obtain, and at the age of thirteen learned surveying. But so many difficulties were encountered in this new field, that he was compelled to resort to farming, which he followed until about seventeen years of age. At that time, receiving the reluctant consent of his father to go to sea, he shipped on board of a sloop bound to New York; but not liking his employer, he entered another vessel bound for Providence. But for the sea Fitch was not adapted. We next find him engaged with a watchmaker near his native town, where he stayed more than two years, in a condition of mere drudgery; at leaving, he knew little or nothing of the trade. He then engaged in the potash business, at which he was equally unsuccessful. On the 29th of December, 1767, he married Miss Lucy Roberts, whom he was soon obliged to abandon on account of a dissimilarity of disposition. After this he forsook his native village, and wandered through the Middle States in search of employment. Failing, he went to New Brunswick, where he engaged in button making. During the Revolution, he repaired arms for the continental army. Subsequently he removed to Kentucky, where he was appointed surveyor. It was while in the exercise of this profession, that he was taken prisoner and subjected to many hardships by the Indians. After his escape, he returned to the Atlantic States.

In 1785 he began to turn his attention to steam as applicable to the propulsion of carriages and vehicles. In 1788, he obtained a patent for the application of steam to navigating the waters of the States of New York, Pennsylvania, New Jersey, Delaware, &c. His boat, finished amid hardship and privation, which none can appreciate but those forced to battle without help for despised innovations, is described by himself in the Columbian Magazine, vol. i. 1786. "The cylinder is to be horizontal and the steam to work with equal force at each end. The mode by which we obtain a

vacuum is, it is believed, entirely new, as is also the method of letting the water into it, and throwing it off against the atmosphere without any friction. It is expected that the cylinder, which is of twelve inches diameter, will move a clear force of eleven or twelve hundred weight after the frictions are deduced; this force is to be directed against a wheel eighteen inches in diameter. The piston is to move about three feet, and each vibration of it gives the axis about forty evolutions. Each evolution of the axis moves twelve oars or paddles five and a half feet; they work perpendicularly, and are represented by the strokes of a paddle of a canoe. As six of the paddles are raised from the water, six more are entered, and the two sets of paddles make their strokes of about eleven feet in each evolution. The crank of the axis acts upon the paddles, about one-third of their length from their lower ends, on which part of the oar the whole force of the axis is applied. The engine is placed in the bottom of the boat, about one-third from the stern, and both the action and reaction turn the wheel the same way."

A day was appointed for the trial of this novel craft. The trial was eminently successful. "A mile was measured," says the inventor, "in Water Street, Philadelphia, and the bounds projected at right angles as exactly as could be, to the wharf, where a flag was placed at each end, and also a stop-watch. The boat was ordered under way at dead water, or when the tide was found to be without movement; as the boat passed one flag, it struck, and at the same instant the watches were set off; as the boat reached the other end, it was also struck, and the watches instantly stopped. Every precaution was taken before witnesses; the time was shown to all; the experiment declared to be fairly made, and the boat was found to go at the rate of eight miles an hour, or one mile in seven minutes and a half. It afterwards went eighty miles in a day."

This was the commencement of steam navigation; but Fitch possessed neither the funds nor the patronage necessary to improve upon his first model. In June, 1792, the company which

had been formed refused to advance more funds, and Fitch's boat was laid up. But his faith in the importance of the subject, and in its ultimate success, continued unabated. His was the true inspiration of genius, which, once acquainted with the principles of a design yet in embryo, can confidently utter conclusions upon it, that afterwards strike ordinary minds as prophecy. In a letter to Mr. Rittenhouse, Fitch says: "It would be much easier to carry a first-rate man of war by steam than a boat, as we would not be cramped for room, nor would the weight of machinery be felt. This, sir, will be the mode of crossing the Atlantic in time, whether I bring it to perfection or not, for packets and armed vessels. I mean to make use of the wind when we have it, and in a calm to pursue the voyage at the rate of seven or eight miles an hour."

Full of these ideas, Fitch went to Europe. But here he was unsuccessful, and returned to Boston poor and wretched. Being offered a home by Colonel George King, a relative, he seems to have passed his time quietly for two or three years, after which he went to Kentucky, to obtain some lands gained while a surveyor, but which had subsequently been occupied by strangers. There he was seized by fever, and died—requesting that he might repose "where the song of the boatman would enliven the stillness of his resting-place, and the music of the steam-engine soothe his spirit."

While Fitch was endeavouring to apply steam to the purposes of navigation, another of our illustrious men, Oliver Evans, was improving upon its application in the common steam-engine. He was born in Newport, Delaware, in 1755 or 1756, and at the age of fourteen was apprenticed to a wagon-maker. While engaged at this occupation, he seems to have thought much upon the possibility of moving carriages without animal power; and the simple circumstance of wadding being discharged from a gun-breach, by heating water in it, suggested to him that steam would be the requisite substitute for horse-power. Experiments strengthened this

opinion; but the want of means prevented him for a while from prosecuting it.

At the age of twenty, finding his occupation of making card-teeth by hand extremely tedious, he invented a machine by which three thousand could be turned off in a minute; but of the benefits arising from this he was in a great measure defrauded. Two years after, he married a Miss Tomlinson, of his native State. We next find him engaged with his brothers, who were millers; and here, his intuitive knowledge of the requisites of machinery obtained ample scope for development. Making flour was at that time a process at once clumsy and tedious. Evans set himself to its improvement; and in a short time he had invented and successfully applied the Elevator, the Conveyor, the Hopperboy, the Drill and the Descender. Their general introduction throughout the country was a work of more difficulty. Ignorance, prejudice, and perhaps envy, were arrayed against them; and many millers of his native State refused to regard his "*rattle-traps*" as improvements, even while they were in operation before them. In 1786, he petitioned the legislature of Pennsylvania for the exclusive right of using through that State his improvements in mills and steam-carriages; but he obtained privilege only for the first. A similar petition, presented in the following year, to the legislature of Maryland, was granted. But this success brought with it no pecuniary assistance; and as late as the year 1800, a scientific gentleman, named Latrobe, in a paper to the American Philosophical Society, pronounced Evans's plans a chimera, and their author a victim of the *steam mania.*

Yet Evans was not disheartened. His was a perseverance like that of Fitch and Whitney. Temporarily abandoning his project of a steam-carriage, he devoted his time to the application of steam to the machinery of mills. On this he exerted his strength and lavished his fortune. An engine was constructed; but its construction had absorbed all his means, and he beheld before him a life of destitution. But the reward of honest exertion—that reward which Fitch had sought in vain—fortune vouchsafed to Evans.

In 1804 he constructed for the Philadelphia Board of Health a machine for cleaning docks. This he launched into the Schuylkill, and, notwithstanding great disadvantages, sailed down that river to the Delaware, leaving behind all other vessels. Previous to launching, he had affixed wheels to it, by which it was run through Market street from river to river. When some ridiculed the slowness of its motion, Evans replied that, on a wager of three thousand dollars, he would construct a machine which, propelled by steam, would run against any horse on a level road. He gave the name of Oructor Amphibolis to his carriage. It was the first American locomotive.

On the 25th of September, 1804, Evans laid before the Lancaster turnpike company a statement concerning the economy of the steam-engine, and solicited their assistance in constructing it. No notice was taken of his project.

On the 28th of January, 1808, he obtained from Congress a renewal of his patent for the improvement of flour-mills. Previous to this, he was subjected to many mortifications in consequence of the numerous infringements on his old right. An attempt, about the same time, to deprive him of the honour of the original invention, signally failed. He died at Philadelphia of an inflammation of the lungs, April 21, 1819.

Evans's exertions were not confined to the agency of steam. While at Philadelphia, he conducted an iron foundery. He also edited two books—The Young Millwright's Guide, and the Young Steam Engineer's Guide. Yet the application of steam to motion was his favourite object. To this, like Fitch, he directed all the energies of his mind; and like Fitch also, his predictions concerning its subsequent success have been converted by time into prophecy. "The time will come when a carriage will set out from Washington in the morning, the passengers will breakfast at Baltimore, dine at Philadelphia, and sup in New York the same day. To accomplish this, two sets of railways will be laid, so nearly level as not in any way to deviate more than two degrees from a horizontal line, made of wood or iron, or smooth paths of broken

stone or gravel, with a rail to guide the carriages so that they may pass each other in different directions and travel by night as well as by day. Engines will drive boats ten or twelve miles per hour, and there will be many hundred steam-boats running on the Mississippi, as predicted years ago."

A character no less distinguished in the history of our early manufactories was Samuel Slater, who, though not an American, well deserves a place among our mechanics. He was born, June 9, 1768, at Belper, Derbyshire, England. He received an ordinary English education, and, after leaving school, entered the cotton establishment of Jedediah Strutt. Soon after, when but fourteen years old, he lost his father. He continued, however, at the cotton spinning, and employed all his leisure time in planning rude machinery or inventing improvements. These early labours were not lost. Cotton spinning was then in its infancy. Almost any alteration which an ingenious mind could make in the process of conducting it would be an improvement. Slater suggested several such to his employer. He had liberality enough to adopt them, and honesty enough to reward the inventor; and before the young apprentice had completed his term of indenture, his influence was felt for good throughout the establishment. But while thus passing quietly through the first stage of his life, he had been forming plans which were to form for him fortune and fame in other circles and another world. It was told him that, in America, the demand for machinists was great; in England competition threatened to render the business almost useless. He determined to abandon his home and country, and to venture on that theatre of action then opening in the land beyond the waters. The boldness of the idea was not more remarkable than the intrepidity of will which could execute it. He embarked September 1, 1789, after dropping in the post-office a letter which conveyed to his mother the first intimations which she had of his design. In sixty-six days he arrived at New York.

Owing to the jealousy of government, he had brought with him no plans of machinery; but his indenture soon obtained for him

some employment. Soon after, he addressed a letter to Moses Brown, of Providence, offering his services as cotton spinner. This was eagerly accepted, and he was admitted to the firm of Alney, Brown, and Slater. Up to this time, the machinery used at Brown's establishment had been rude and unprofitable. Slater saw this at a glance, and, with the consent of the firm, set himself to its improvement. After numerous trials, during which his only guide was his memory, he succeeded in making cards and spindles on the English model. These were started December 21, 1790, and, after some amendments, worked in an admirable manner. About this time he boarded at the house of Friend Oziel Wilkinson, who, in no long period—strange as it may seem under the circumstances—became his father-in-law. The union of the young adventurer with Miss Hannah Wilkinson was an event in every respect happy and fortunate.

In 1793, a small factory was built by the firm at Pautuckut. From this time their business seems to have steadily increased, as the population increased around them. Slater resorted to the admirable plan of instructing the operatives. A Sabbath-school, the first in the United States, was established at his house, where he sometimes taught in person.

Mr. Slater's death occurred in 1835. His character was without a blemish as a Christian; without a fault as a man of business. Never did any man conform more strictly to the homely maxim—a time and place for every thing, and every thing in its place. As a machinist, he is among the foremost of our benefactors. It will be remembered, that, when he left England, he had no drawings of any sort, but trusted solely to the powers of his memory for constructing complicated machinery. At that period the few men of mechanical genius in America had no opportunity for exerting their talents; and Slater was not unfrequently at a loss for men to work on his wooden models. Yet was his genius adequate to every emergency. A single illustration may be given. In 1790, after having started his cards and spindles, the teeth of the cards fell back, thus rolling up the cotton instead of permitting it to pass

through. This was occasioned by the bad quality of the card leather, and from the punctures having been made by hand. The whole machinery was consequently useless. After a season of anxiety, Slater resorted to the expedient of beating the teeth to the proper crook with a piece of grindstone. This being done, the difficulty was obviated.

With the early history of our cotton manufactures is associated the name of AMOS WHITTEMORE, the inventor of the card machine. He was born April 19, 1759, at Cambridge, Massachusetts. His father possessing but slender means to rear a large family, young Amos received but a limited education, except in that important branch of knowledge—farming. But his talent for science and mechanism early evinced itself; and when at the proper age to make choice of a trade, he selected that of gun-smithing. Once fairly embarked in permanent employment, he devoted to it all his energies, employing spare time in planning improvements which he could not operate upon during the day. Before his apprenticeship had expired, he had thoroughly mastered his trade, and was advised by his employer to enter into the business. How he was employed for a few years immediately succeeding his apprenticeship we are not informed. We next see him associated with others in the manufacture of wool and cotton cards, then a feeble and not very lucrative business. The staples used were placed one by one through holes punctured in leather, a work in which only children were employed. Whittemore was not long in detecting the room for improvement. It occurred to him that a machine might be constructed which should not only pierce the holes in the card, but draw the wire from the reel and send it through the holes. This idea he communicated to his brother, by whom he was encouraged to persevere. The generous impulse was not lost. He began the execution of the project with an ardour which scarcely permitted him time to eat or sleep—which impaired his health and wasted his strength. At the end of three months, he had so far progressed as to be able to draw the wire, cut and shape it, and pierce the

holes in the leather. One great difficulty remained, without obviating which these improvements were useless. It was to bend the wire after it had been placed. After taxing his ingenuity to the utmost he finally agreed to abandon the undertaking; and we are assured on good authority that, having done so, he was induced to resume it only through a very singular agency. He dreamed one night of an addition which would accomplish the requisite labour. In the wildness of hope, he set himself on the following day to apply it, and was rewarded with complete success. The result was that machine which, for the ease and regularity of its complicated operations, has been compared by Edward Everett to the workings of the human system.

The labours of the two brothers had to a great extent been kept secret; so that when the machine was finished, there was a good prospect of reaping the reward of their labours. On the 2d of June, 1797, he secured a patent-right for the term of fourteen years. Two years after, the inventor sailed to England, to solicit a patent from the government there. In this he was unsuccessful, meeting only with loss and disappointment, and being finally obliged to embark for Boston, much poorer than when he left America. The vessel was captured by the French, but Whittemore escaped without serious inconvenience.

From this time until 1809, Whittemore appears to have been engaged principally in the construction of machinery which embodied his new improvements. But he was straitened by want of funds; and the patent was within a few years of its expiration. In this dilemma he determined to exhibit before Congress a full-size model of his machine, with a view of obtaining a renewal of the patent. The result was highly gratifying—an extension of the patent to double the term originally named. This was in 1809. The fame of Whittemore's invention, thus encouraged by Congress, spread rapidly. Men of fortune and influence directed their attention to it. In 1812, the New York legislature incorporated the New York Manufacturing Company with a capital of $800,000. One of the purposes of its establishment was the purchase of Whit-

temore's patent and machinery. This was effected July 20, 1812, for the sum of one hundred and fifty thousand dollars. The company then purchased suitable grounds, and proceeded to the erection of suitable buildings. The condition of the country at that time favoured their operations; and the manufactures, with Whittemore's machinery, speedily rolled a tide of wealth into the coffers of the proprietors. This prosperity closed however with its fostering cause—the war of 1812. Destitute of government protection, the company were unable to compete with their foreign rivals; their business dwindled away until 1818, when a sale of the entire establishment was made to Samuel Whittemore, the brother, and Timothy Whittemore, the son, of the original inventor. Soon after, the former became sole proprietor.

Whittemore took little active interest in his machinery after the sale of his patent. In the quiet and seclusion of his estate, near Cambridge, he enjoyed a repose, more sweet on account of following the restless activity of younger days. He projected, it is believed, an improvement of the orrery, by which that instrument would be made to conform very near to the actual planetary movements; but this was never carried into execution. He died at West Cambridge, in 1828.

New England, the birth-place of so many of our early mechanics, includes among her sons the distinguished THOMAS BLANCHARD. He was born June 24, 1788, at Sutton, Worcester Co., Massachusetts. Like most men of genius, he gave early indications of the talents which afterwards rendered him remarkable. His father, being a respectable farmer, was enabled to send him during the greater part of the year to a school in the neighbourhood, where he acquired such an education as could then be obtained in a New England village. But the mind of young Blanchard was not fashioned for literary pursuits. His out-door time was occupied in cutting ships and wind-mills from shingles, in constructing rude machinery, and investigating the mechanism of tools and furniture. A curious anecdote is told of his first experiment in metals. When

ten years old, he accompanied his father to a blacksmith's shop. The process of horse-shoeing attracted his attention; he was filled with admiration at the sight of two pieces of iron being welded into one; the wondrous idea haunted him on his way home; and his mind was bent on performing the operation for himself. Seizing an opportunity when the family were absent, he constructed a brick forge in an old weave-shop adjoining the yard, made a wedge answer for an anvil, built his fire, and with the assistance of the kitchen bellows, heated some scraps of iron. But his efforts at welding failed, for he had as yet no knowledge of the requisite degree of heat. Not discouraged, he resolved on a special visit to the blacksmith's shop; but before this could be effected his father returned, and the iron business seems to have been for a while laid aside.

His next experiment was more successful. Having heard of a machine for paring apples, he determined to make one for himself. The first trials were so far successful as to cause the apple to revolve on a crank; but instead of the cutter paring, it sunk into the apple. This difficulty he obviated by fixing a gauge to the knife, which regulated its motion, in a manner similar to the action of the thumb. The happy result of this juvenile effort gained him much celebrity in the neighbourhood; and, what was of more importance, awakened him in a measure to a consciousness of his own talents.

Blanchard now entered in the employment of his elder brother. The business was making tacks—a business at that time most tedious, discouraging, and unprofitable. Every thing was executed by the hand. The tacks were cut from a thin plate, then lifted up one by one and placed in a holder, then capped separately by a blow of a hammer. To the ardent activity of young Blanchard such a process was insufferable. He soon constructed a machine for counting his tacks, a work which had formerly occupied a large portion of the operative's time. This his brother pronounced an idle project. It appears that he soon after left the business; but not before he had determined that if opportunity should offer, he would invent a machine for the making of tacks. He now turned

his attention to the choice of a profession. Happily his father, though a sound practical farmer, and anxious to see his son the same, was not altogether blind to the use of mechanical arts. Young Blanchard was allowed to pursue the bent of his inclinations—assisted with the wholesome advice to learn thoroughly whatever he attempted. Blanchard was faithful to his first love—blacksmithing; but he also acquired a practical knowledge of turning and other wood-work. He began business in a manner worthy the promise of younger days. At the same time he remembered the resolution made while cutting tacks. At eighteen, he began his experiments upon the proposed machine; and for six years, amid poverty, discouragement, and perplexity, the dissuasions of the friendly, and the ridicule of the jealous, he laboured at its construction. He succeeded admirably. By his machine five hundred tacks can be made in a minute, superior in appearance to any made by hand. After securing his patent he sold the right to a company for five thousand dollars.

Through the solicitation of a friend, Blanchard now turned his attention to some suggested improvements in the manufacture of muskets. Then, musket barrels were brought to a uniform external finish by grinding; it was desirable to effect this with the lathe. To invent the requisite machine, Blanchard now taxed his ingenuity; and so complete was his success, that, by means of a change in the axis of motion, he not only turned the barrel, but also a differently shaped portion of the breach. It was exhibited under flattering circumstances in the national armory at Springfield, and a contract made with the superintendent to erect one at that place.

A still more important invention was in reserve. A taunting remark made by a workman during the exhibition at Springfield, had suggested the possibility of the gun-stock itself being turned by machinery. From that moment it occupied his attention; and when by a strong effort of mind the whole plan of such a machine was brought before him, he burst into the exulting language—"I have got it." A model was speedily constructed. Not only gun-stocks, but spokes of wheels, shoe-lasts, hat-blocks, &c., could be

turned by it. A patent was soon obtained, and contracts made with government. He was thus engaged for five years, during which he produced numerous other improvements in the manufacture of muskets. The patent was renewed in 1833.

Notwithstanding these multiplied inventions, which were necessarily fatiguing, we find the attention of Blanchard early directed to the subject of steam as a propeller. When his contract with government had expired, he constructed a carriage, similar to those now used on our railroads. For this he secured a patent. Some further inventions were so evidently important even at that time, as to receive from a committee of the Massachussets legislature, the eulogium of being "valuable improvements, and peculiarly adapted for use in this country:" as such they were "recommended to all the friends of internal improvements." The people thought otherwise. No effort was made to carry forward the scheme in New England; a similar fate attended it in New York; and Blanchard, less persevering or less improvident of means than Fitch or Evans, abandoned it.

About this time (1825–6) the numerous difficulties attending the navigation of Enfield Falls in the Connecticut began to claim much attention. It was accomplished in flat-boats which, among contrary winds, were knocked about among shoals and breakers, to the great risk of life and property. A company suggested the use of steamboats; and Mr. Blanchard was employed as their agent. The first boat was unmanageable. A canal was then built at great expense, and a second boat launched. It likewise proved a failure. These disasters led to a thorough investigation of the defects in the steamboats then used, and the discovery of several important remedies. These were embodied in a model boat, which met the wants of the company, ascending the falls with ease, and plying daily between Springfield and Hartford. In 1828, he ascended the river through the Connecticut valley. His progress was hailed by the acclamations of thousands who had never seen a steamboat, and whose shouts were mingled with the clangor of bells and roar of cannon. He soon after built a larger boat on a greatly improved plan.

Blanchard had now demonstrated the immense importance of steam navigation in ascending rapid or shoally rivers. In a country like ours, a fact of this nature once demonstrated, cannot fail soon to influence trade generally. Prejudice melted before it; envy was silenced. Contracts for the construction of similar boats followed each other with rapidity. Soon one of Blanchard's boats was mounting the falls of the Alleghany; another was navigating the Ohio. Yet his prosperity was not unalloyed by mortifications brought on by those who endeavoured to infringe upon his patents. The one for securing the turning of gun-stocks was obtained only by the accidental circumstance of his having shown and described the model to two friends previous to applying for the right. In 1834 he instituted a suit against some infringers on this same patent; but owing to a defect in the grant, it failed. A second patent was taken out, a second suit instituted, and the court decided for Blanchard. He afterwards stationed himself in New York city, where he still continues to pursue his favourite mechanical studies.

Somewhat similar in inclination to the genius of Blanchard was that of Jacob Perkins, so extensively known both in this country and Europe. He too is a son of the Pilgrims, and was born July 1766, at Newburyport, Massachusetts. Of his early life, we know little or nothing. At the age of thirteen he was apprenticed to a goldsmith, principally it would seem, on account of the talent he had evinced for mechanical employments. He gained the esteem of his master, and proved his gratitude for it by inventing a machine for plating shoe-buckles with gold. When twenty one, he was employed in the State mint of Massachusetts, to make dies. This flattering prospect encouraged him to attempt a machine for cutting and heading nails. He succeeded; but through the profligacy of his associates, lost the rewards of his success, and was reduced to destitution. To extricate himself, he made a stamp to prevent the counterfeiting of bank-bills, which, in 1809, was followed by the invention of the check-plate. These being but partially encouraged, he removed to Philadelphia, and thence to England. It was during

his somewhat uncertain sojourn in the Middle States, that he effected the improvements in hardening and softening steel.

In England, his attention was directed to a different branch of science. It was one of the axioms of philosophy at that time that water was incompressible. Reasoning from analogy and from the nature of that fluid, Perkins was induced to doubt the correctness of this opinion. He commenced a series of experiments upon water; by novel and ingenious variations he established the truth of his opinion, and invented two instruments, the Bathometer for measuring the depth of water, and the Pleometer for determining the rate at which a vessel moves through water. Prosecuting his experiments with water, he was led to apply steam to the purposes of artillery, and to these his celebrity in Europe is in a great measure due. The substitution of this powerful agent for gunpowder had long been considered practicable on that continent; and several eminent men had been partially successful in the experiments upon it. But Perkins' studies were far more bold and important than any of his predecessors. Experiments were made before the Duke of Wellington and Prince Polignac. In the first, the balls were shattered to pieces when fired against an iron target, and when directed against heavy deal boards, one inch thick, passed through eleven in succession. Balls were also projected in a lateral direction, and in an axis nearly at right angles with that of the discharge. He calculated this new mode of warfare as follows: "Suppose two hundred and fifty balls are discharged in a minute by a single-barrelled gun, or fifteen thousand per hour; this, for sixteen hours, would require about fifteen thousand pounds of powder, which at seventy shillings per hundred weight, would cost five hundred and twenty pounds. But the same number of balls can be thrown in succession, and in the same time, for the price of five bushels of coal per hour, or about two and a half pounds for fifteen hours."

Perkins was now employed in constructing a cannon designed to throw sixty four-pound-balls in a minute. To the machinery by which this was discharged, he attached a contrivance for throw-

ing a stream of lead from the bastion of a fort. But the engineers of both France and England pronounced the project impracticable; a verdict which most scientific artillerists have confirmed.

One invention of Mr. Perkins, of far more importance than his applications of steam, remains to be noticed. By using his methods of softening and hardening steel, in connection with the printing of calico, he was enabled to transfer designs from plate to plate, in the greatest perfection, and the drawing is taken from plate to cylinder, or from cylinder to plate, as convenience requires. This invention is now in extensive use throughout our country. The inventor is still living.

David Bushnell was born in Saybrook, Connecticut, about the year 1742. The history of his boyhood is almost a perfect blank. He lived with his father, a farmer in very moderate circumstances, until twenty-seven years old. His father dying, he removed to the town and began preparation for college. His pastor, the Reverend John Devotion, encouraged and assisted him. He was also assisted by a gentleman named Tally; and under their kind protection his studies proceeded rapidly. In 1771 he entered Yale College. We lose sight of him again until 1775, when he graduated. It will be remembered that the great struggle between England and her colonies had then commenced.

While immured in the walls of Yale College, Bushnell had perfected those plans concerning submarine warfare, to which he subsequently owed the greater part of his fame. How they were suggested to him is, we believe, unknown; as are also his early experiments. The scheme was entirely his own; for of the few previous attempts at attaining a similar end he was ignorant. "A scheme is said to have been tried in the reign of James the First, by Cornelius Drebell, a famous English projector, who, we are told by Mr. Boyle, made a submarine vessel which would carry twelve rowers, besides the passengers; and that he had also discovered a liquid which had the singular property of restoring the air when it became impure by breathing. This last circumstance, with the

number of persons enclosed in the machine, and the imperfect state of mechanics at the period alluded to, render the whole story extremely improbable, though it shows clearly that the idea had been entertained, and perhaps some attempt made. Another contrivance is mentioned by Mr. Martin, in his Philosophia Britannica, as the invention of an Englishman, consisting of strong thick leather, which contained half a hogshead of air so prepared that none could escape, and constructed in such a manner that it exactly fitted the arms and legs, and had a glass placed in the fore part of it. When he put on this apparatus he could not only walk on the ground at the bottom of the sea, but also enter the cabin of a sunken ship, and convey goods out of it at pleasure. The inventor is said to have carried on his business for more than forty years, and to have grown rich by it."

This scheme bears no resemblance to Bushnell's; and indeed there are strong reasons to believe that it never went into execution, except in the inventor's brain. Bushnell's application of submarine navigation to the destruction of vessels was certainly new. His plans were entered into with some spirit, and sanguine expectations were aroused that they could be rendered effective against the British shipping. He first experimented with a small portion of powder, to prove that that substance could be ignited under water. In a second trial, two pounds of powder were enclosed in a wooden bottle and fixed under a hogshead with a two-inch oak plank intervening. The hogshead was loaded with stones as deep as it could swim; a wooden pipe primed with powder descended through the lower head of the hogshead, and thence through the plank into the powder contained in the bottle. A match applied to the priming caused a tremendous explosion, casting a great body of water with the stones and ruins many feet into the air. Subsequent experiments, some of them on a larger scale, were attended with equal success.

The machine in which he embodied the results of these experiments was denominated the Torpedo. Externally it bore some resemblance to two upper tortoise-shells of equal size, placed in contact, leaving at that part which represents the head of the ani-

mal, a flue or opening sufficiently capacious to contain the operator, and air to support him thirty minutes. At the bottom, opposite the entrance, was placed a quantity of lead for ballast. The operator sat upright, and was furnished with an oar for rowing forward or backward, and with a rudder for steering. An aperture at the bottom with its valve admitted water for the purpose of descending, and two brass forcing-pumps served to eject the water within, when necessary, for ascending. The vessel was made completely water-tight, furnished with glass windows for the admission of light, and with ventilators and air-pipes; while leaden ballast was fixed at the bottom so as to render it solid, and obviate all danger of oversetting. Behind the submarine vessel was a place above the rudder for carrying a large powder magazine. This was made of two pieces of oak timber, large enough, when hollowed out, to contain one hundred and fifty pounds of powder, with the apparatus used for firing it, and was secured in its place by a screw turned by the operator. It was lighter than water, that it might rise against the object to which it was intended to be fastened.

Within the magazine was an apparatus constructed so as to run any proposed period under twelve hours. After running out the time for which it was set, it unpinioned a strong lock resembling a gun-lock, which gave fire to the powder. This apparatus was so pinioned that it could not move, until, by casting off the magazine from the vessel, it was set in motion. The skilful operator could swim so low on the surface of the water as at night to approach very near a ship without being discovered. Even above water, he could approach either bow or stern with but little danger. He could sink very quickly, keep at any necessary depth, and row a great distance in any direction without coming to the surface. On rising to the top, he could soon obtain a fresh supply of air, and if necessary, descend again and pursue his course.

Such is a description of this singular apparatus. Still a difficulty remained. To put the machinery in operation required a degree of coolness, ingenuity, and daring, greater than that which belongs to the generality of men. Bushnell found that much instruction and

many trials were required to render a man of ordinary tact skilful in its management. He first employed his brother; but this gentleman, after making himself master of it, was unfortunately taken sick. His place was supplied by a sergeant of one of the Connecticut regiments. After receiving such instructions as time would allow, he was directed to try an experiment on the Eagle, a sixty-four gun ship, lying in the harbour of New York, and commanded by Lord Howe. General Putnam was stationed on the wharf to witness the result.

The sergeant went under the ship and attempted to fix the wooden screw into her bottom, but struck, as he supposed, a bar of iron, which passed from the rudder hinge, and was spiked under the ship's quarter. Had he moved a few inches, which might have been done without rowing, there can be little doubt that he would have found wood; or had the ship been sheathed with copper, it might easily have been pierced. But wanting the skill necessary to the management of his vessel, the sergeant, in attempting to move to another place, passed out from under the ship. After vainly groping about for her, he rose to the surface. Daylight was now so far advanced that he could not renew the attempt except at the risk of being discovered by the sentinels. In returning to New York, and while near Governor's Island, he thought he was discovered by the British stationed there. To avoid danger, he cast off his magazine, imagining it retarded him in the swell, which was very considerable. The internal apparatus being set to run one hour, it blew up at the end of that time. The explosion was tremendous, a vast column of water being thrown high into the air, much to the astonishment of the enemy. A few other attempts upon vessels lying in the Hudson met with similar ill success.

In 1777, Bushnell attempted to blow up the Cerberus frigate, lying off New London, by drawing a machine against her side by means of a line. The powder was to explode by means of a gun-lock, unpinioned by an apparatus set in motion by striking the vessel. The line, buoyed up by pieces of light materials placed at regular distances along its length, was perceived by some men

on board a schooner near the Cerberus, and they immediately began to haul it in. On feeling the machine, they unconsciously drew it on deck, where it soon exploded, shattering the schooner to pieces, and killing three men. In December of the same year, Bushnell charged a number of kegs with powder, in such a manner as to explode on striking against any thing. His design was to float them down against the British shipping. Unfortunately for the scheme, the proper distance could not be well ascertained; and, when set afloat, the kegs became entangled with the broken ice. In the morning they approached nearer. One blew up a boat, others exploded against the ice. The consternation of the British seamen and soldiers at this strange spectacle furnished matter for Judge Hopkinson's comic song—*The Battle of the Kegs.*

Bushnell's efforts being unfortunate, his ingenuity did not receive the reward it had merited. After wasting his substance for his country, he received nothing in return. At the close of the Revolution he went to France; and for a long while his name and history were lost. It was generally supposed that he had perished during the commotions of 1789; but, in 1826, his relatives were astonished by the news of his death, accompanied by a handsome bequest. Returning from Europe, he had settled in Georgia, under the name of Bush, and there died.

A character well deserving a place among our illustrious mechanics, was Henry Eckford, born at Irvine, Scotland, March 12, 1775. After engaging in ship-building at Quebec, he settled at New York, where he pursued the same business. He soon obtained extensive patronage, gradually improving upon former plans, until his vessels were known throughout the country as the best, both in idea and execution, ever built in America. At the opening of the war of 1812, he contracted with government to construct war vessels for lake service. The difficulty of the enterprise was great; but with the most praiseworthy perseverance, Eckford overcame them all, and launched one by one those ships of the line, brigs, and war-sloops, which were indispensable to the success

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of our border warfare. At the close of the war he diligently pursued his useful occupation. Among its first fruits at that period was the Robert Fulton, a stout-built steam ship, designed to ply between New York and New Orleans. Her owner dying suddenly, she was soon afterwards sold to the Brazilian government, and converted into a war-sloop of twenty-four guns.

Eckford now received an invitation from the secretary of the navy to be naval constructor at Brooklyn. His object was to secure the construction of a model line-of-battle ship for ocean service. Eckford produced the Ohio; but he seems to have modified the instructions of the board of commissioners, according to his own sense of the requisites of war-ships. This produced some vexatious collisions between the parties, which resulted in Eckford's resignation. The Ohio was launched but not put in commission for eighteen years. But the builder's reputation was not impaired. From all quarters he received orders for vessels. Frigates and men-of-war were built for different European powers; four sixty-four gun ships were finished for Brazil and Columbia, in the space of eighteen months, and proposals reached him for building two frigates for Greece. By request of President Jackson, he sketched a plan for an entire reorganization of the naval department; though much admired, it was never put in execution.

Yet this career of prosperity was not without interruption. By the bankruptcy of an insurance company, in which he had invested a large amount of money, he became involved in disheartening disputes, and a few of his more malignant enemies went so far as to impeach his integrity. The manœuvre redounded little to their credit. Eckford proved that he had sacrificed nearly half a million to save the company, and, after a thorough investigation, he was honourably acquitted.

In 1831, he built a sloop of war for Turkey, which country he soon after visited. Here he was employed by the Sultan Mahmoud, as chief naval architect of the empire. He had begun the construction of a man-of-war under the most flattering evidences of the Sultan's favour, when an attack of inflammation of the bowels caused his sudden death, November 12, 1832.

In connection with navigation and steam-power, one illustrious name is still to be mentioned—ROBERT FULTON. Little Britain, in Pennsylvania, was his birth-place, 1765. His early education was limited, save that his peculiar genius frequently manifested itself so as to surprise his associates. So assiduously did he cultivate his talent for painting, that at the age of seventeen he supported himself by it in Philadelphia. At the age of twenty-one, he settled his widowed mother upon a small farm in Washington county, and soon after visited England, for the purpose of becoming acquainted with Mr. West. The acquaintance was formed; and under the instructions of that celebrated painter, he remained for several years.

The influence of his patron introduced him to the notice of several distinguished artists, and for some time he seems to have pursued this art as his settled business.

At what period Fulton's attention was first directed to the subject of inland navigation, we do not know. He was engaged in mechanical projects during the revolutionary war. In 1793 he expresses confidence in the practicability of applying steam to ships. In the year following, he received from the British Society for the promotion of Arts and Commerce, a medal and vote of thanks for his improvement in the art of sawing marble. Several other inventions were his; and about this period, we find him abandoning the pencil, for the occupation of engineer. Drafts of his proposed or executed improvements were from time to time sent to the United States. His motive for attempting some of these, deserve notice on account of their enlarged and liberal humanity. The schemes of submarine navigation were designed to render warships useless, and thus compel nations to live in peace with each other, on account of the futility of war. His perseverance to accomplish this plan deserves our admiration. In 1797, he entered the family of Mr. Barlow, then at Paris, in whose company he experimented in the Seine upon a machine designed to give gunpowder a progressive motion under water. The trial failed. Not discouraged, he perfected his plan of a submarine boat, and applied to the French Directory for funds to execute it. Failing in this, he constructed a handsome model, and again applied to the Directory. His success was no better than on the former occasion; and an application to the British government also failed. But when the Directory had fallen, Fulton's proposals were cordially entertained by Bonaparte, and funds granted him to a considerable extent. He experimented at Brest, July 3, 1801. In a plunging boat, he performed on the surface all the evolutions of an ordinary vessel, plunged to a depth of twenty-five feet, advanced, receded and turned at that depth, and remained there half an hour. On the 7th of August, by means of air compressed into a copper globe, he remained below the surface four hours and twenty

minutes. With his torpedoes he struck a vessel at two hundred yards distance and shivered her to atoms. This latter invention he designed to practise upon the British vessels then lying near the coast. But the British admiral seems to have received some intimations of this design, and kept his ships at a safe distance from shore. Meanwhile the French government became discouraged and withdrew its patronage.

In 1804 Fulton received an invitation to visit England, which he accepted. At an interview with Mr. Pitt and Lord Melville, he exhibited and explained his drawings of the torpedo, but had the mortification to perceive that it was coldly received. In truth, the British ministry, proud of their naval domination and jealous of improvements, seemed to have dreaded the publication of Fulton's plans. Some experiments were permitted, several of which failed; but on the 15th of October, 1805, a completely successful effort blew up a Danish brig of two hundred tons burden, lifting her out of the water and breaking the hull in two. These experiments, established beyond a doubt the practicability of Fulton's theory. Still he remained unrewarded; and in the winter of 1806 he returned to his native country. Here he received some encouragement. In the following year, July 20, 1807, he blew up a brig in New York harbour. In 1810 five thousand dollars were voted by Congress, and Commodore Rodgers prepared the sloop Argus to resist the torpedoes. Fulton was ignorant of the means of defence; his men were to a great extent ignorant of his own machinery, and the Argus escaped. This result seems to have puzzled the commissioners appointed to superintend the experiment, and led to a long letter from Fulton to the Secretary of the Navy. Virtually it ended in nothing.

Fortunately, Fulton was unable to pursue his schemes of submarine warfare. Higher destinies awaited him; he who was abandoned by the French Directory, and coldly passed by, by the English, was destined to accomplish a revolution in the social and national relations of men, concerning which few at that day dreamed. His attention had early been directed to the properties of steam.

Other projects had subsequently occupied his mind; but these having failed, he once more turned to the consideration of steam. Aided and encouraged by Chancellor Livingston, he built a boat for experiment in 1803. This was in France. The French Institute and other bodies were invited to see it launched. This launching took place in August, and its result was highly gratifying to the inventor. He then employed Watt and Bolton of England to construct an engine, without intimating its object; and about the same time, through the efforts of Mr. Livingston, obtained the passage of an act in the New York Legislature, confining the navigation of the waters of that State, by fire or steam for twenty years, to himself and his patron. He now repaired to New York, and began the construction of his first American steamboat. It was launched early in 1807, and in August of the same year—a proud period for the inventor and his country—was put on trial. On that day ignorance, prejudice, and stupidity, bowed to the majesty of science. Fulton's success was complete; and an agent, mighty for good or evil, was roused from its slumber of ages, to be subjected to the will of man. The boat which thus commenced navigation by steam, was named the Clermont. Soon after crossing the East River, Fulton made a trip with her to Albany, and this soon became her regular track. So repeated were the attempts to injure her that the State of New York declared them public crimes, punishable by fine and imprisonment. That body further protected the inventor, by extending his exclusive right to thirty years. Several other boats were built for the Hudson, and in 1809, Fulton patented his invention. Two years later he obtained a patent for some improvements; and in 1812, he constructed two ferry boats for the Hudson river. Each consisted of two hulls, joined by a bridge, and so constructed as to move backward or forward with equal facility.

In 1814 Fulton was employed by government, to build one or more floating batteries, for the defence of the national waters. The first of these was launched in October of that year, amid thousands of spectators; and in the following May the engine was

put on board. The vessel was tried July 4th, and found to move at the rate of five miles an hour.

While this work was in progress, Fulton was engaged in planning a submarine boat, for government use. His model was approved, and he began the work. It was never finished. Early in 1815, he caught cold by long exposure on the ice; the violence of the attack broke through his constitution, and baffled the exertions of science. On the 24th of February, 1815, he terminated his useful and honourable life, in the fiftieth year of his age.

David Rittenhouse.

The American astronomer, RITTENHOUSE, whose celebrity has given a name to his native town, was born April 8, 1732, near Germantown, Pennsylvania. His early days were spent at the plough; the construction of which seems to have been more interesting to him than its use. At the age of seventeen, and without having received any instruction in mathematics, he constructed a

wooden clock. This caused his father to place him under the instructions of a mathematical instrument maker, with whom he remained until twenty-one. When released from the labours of the day, he studied such mathematical works as were within his reach. Before the age of twenty-one he could read Newton's Principia, and had invented that ingenious piece of mechanism the orrery. His instrument differed from all others having the same object, on account of its pointing out with accuracy the positions of the primary and secondary planets, for any time, past, present, or future. Two he made with his own hands, one of which is now owned by the University of Pennsylvania, the other by Princeton College. In 1769 he was appointed by the American Philosophical Society, one of a committee to observe the transit of Venus over the sun's disc, June 3. The result was so creditable to his professional knowledge, that he was employed by government in several important geodesic operations. In 1779, we find him appointed by the Pennsylvania Legislature, as one of the commissioners for adjusting the territorial dispute between that State and Virginia. In 1786, he was appointed on a similar business with New York. In the following year, he was a member of the commission for adjusting the boundary between the latter State and Massachusetts. In 1782, he was elected a member of the American Academy of Arts and Sciences. In 1791 he succeeded Dr. Franklin in the presidency of the American Philosophical Society. In 1795 he was made a member of the Royal Society of London.

These were some of the laurels bestowed by science; others were given by government. In 1777, he was appointed Treasurer of Pennsylvania, in which office he continued until 1789. In 1792 he received the directorship of the U. S. Mint. Soon after, his constitution, naturally delicate, began to decline, and he died on the 26th of June, 1796. "In private life," says the American Encyclopedia, "Doctor Rittenhouse exhibited all those mild and amiable virtues, by which it is adorned. As a husband, a father, and a friend, he was a model of excellence. Immediately after his decease, the American Philosophical Society decreed him the honour of a public

eulogium; and this duty was executed in the ablest manner by Doctor Rush.'

Count Rumford.

As a patron of learning, BENJAMIN THOMPSON, afterwards Count Rumford, deserves a notice in this connection. He was born at Wobury, New England, 1752, and when quite young studied Natural Philosophy under the professor of Cambridge College. Subsequently raised to independence by a fortunate marriage, he became major of militia; and when the Revolution broke out, employed the knowledge thereby obtained in aiding the mother country. At first he was employed under Lord George Germaine; afterwards he raised a regiment of dragoons in New York and became its colonel. In 1784, he was knighted in England, and re-

ceived an appointment. Afterwards we find him in the service of the Elector-palatine of Bavaria, by whom he was much esteemed. For his services in the cause of pauper reformation, he was created lieutenant-general, and Count Rumford. In 1799, he returned to England, where he employed his time in philosophical researches, especially upon the nature of heat. He then suggested the plan of the Royal Institution, and aided in carrying it out. In 1802, he removed to Paris, and married the widow of Lavoisier, from whom however he soon separated. He then engaged in the study of chemistry and experimental philosophy, living in a style of happy retirement, and affording assistance to several in the same pursuits. He died August, 1814. His papers on scientific subjects are numerous, besides four volumes of essays, chiefly philosophical. At his death, a daughter by his first wife was living in Boston.

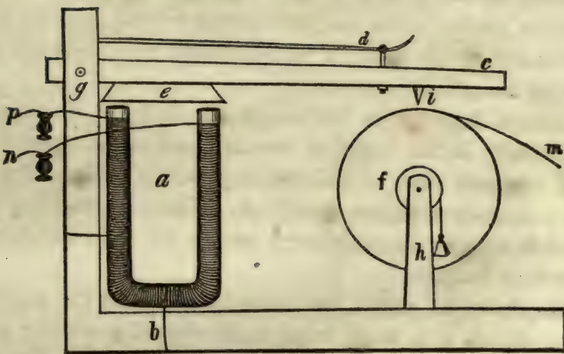
The distinguished artist Samuel Finley Breese Morse is still living, and has his residence in the State of New York. He is a son of the late Rev. Jedediah Morse, D. D., a clergyman of distinction, formerly of Charlestown, Massachussetts. Mr. Morse graduated at Yale College, in 1810. For many years he had occupied an enviable reputation, both in Europe and America, as a painter. Within a few years, he has produced a wonder-working and important machine—the *Electro-Magnetic Telegraph*—which is now in successful operation over thousands of miles in various States of the Union ; and the time is not far distant when lines will be established between all the important cities of the country.

The following is a description of Mr. Morse's machine, for which we are indebted to Dr. Comstock's System of Natural Philosophy.

The temporary magnet *a*, enveloped with its insulated copper wire, is fastened to the wooden frame *b*, *g*, by means of cords or otherwise.

This frame also supports the standard *h*, which sustains the revolving drum *f*, on which the paper to receive the emblematical alphabet is fixed, *m* being the edge of the paper.

To the arm *g*, is appended the lever *c*, of wood, which has a slight



Principle of Morse's Telegraph.

vertical motion, in one direction by the steel spring *d*, and in the other, by the armature of soft iron, *e*.

The two poles of the magnet rest in two little cups of mercury, into which are also to be plunged the poles of the magnetic battery, (not shown in the drawing,) of which *p* is the positive, and *n* the negative. The steel point *i*, attached to the lever, is designed to mark the telegraphic alphabet on the paper.

Having thus explained the mechanism, we will now show in what manner this machine acts to convey intelligence from one part of the country to another.

It is necessary to observe that when a bar of soft iron surrounded by insulated copper wire, as shown at *a*, has its two poles connected with the poles of a galvanic battery, the iron instantly becomes a magnet, but returns to its former state, or ceases to be magnetic, the instant the connection between them ceases.

To break the connection, it is not necessary that both of the poles should be detached, the circuit being broken by the separation of one only.

Supposing, then, that *n* and *p* are the poles of such a battery, on placing *n* into the cup of mercury, the wires from the soft iron being already there, the armature *e* is instantly attracted, which brings the point *i* against the paper on the revolving wheel *f*. If *n*

is instantly detached after the point strikes the paper, then only a dot will be made, for the magnetic power ceasing with the breaking of the circuit, the spring *d* withdraws the point from the paper the instant the pole is removed.

If a line is required in the telegraphic alphabet, then the pole is kept longer in the vessel of mercury, and as the alphabet consists of dots, and lines of different lengths, it is obvious that writing in this manner cannot be difficult. The understanding of the alphabet is another matter, though we are informed that this may be done with facility.

The marks of the point *i*, are made by indenting the paper, the roller on which it is fixed being made of steel in which a groove is turned, which the paper is forced into by the point. The paper is therefore raised on the under side like the printing for the blind.

The roller *f* is moved by means of clock-work, having a uniform motion, consequently the dots and lines depending on the time the point is made to touch the paper, are always uniform.

Now with respect to the distance apart at which the temporary magnet and writing apparatus, and the battery, are placed, experiment shows that it makes little difference with respect to time. Thus, suppose the battery is in Hartford, and the magnet in New York, with copper or iron wires reaching from one to the other. Then the telegraphic writer at Hartford, giving the signal by means of an alarm bell, that he is ready to communicate, draws the attention of the person at New York to the apparatus there,—the galvanic action being previously broken by taking one of the poles from the battery at Hartford.

If now we suppose a letter *a* is signified by a single dot, he at Hartford dips the pole in the cup of the battery, and instantly at New York the soft iron becomes a magnet, and a dot is made on the paper, and so, the rest of the alphabet.

The wires are carried through the air by being wound around glass caps supported by iron L shaped arms, which are driven into wooden posts about 20 feet from the ground. These posts are erected for this purpose, chiefly on the railway lines, from 50 to 100 feet apart.